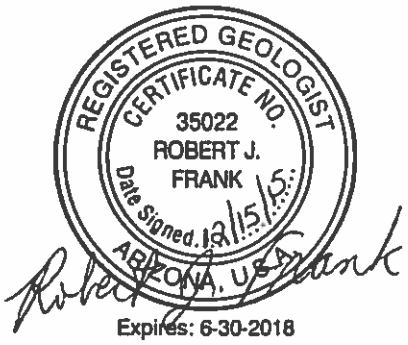
PROPOSED REMEDIAL ACTION PLAN
WEST VAN BUREN AREA WATER QUALITY ASSURANCE REVOLVING FUND SITE
PHOENIX, ARIZONA

Prepared For:

Arizona Department of Environmental Quality

Prepared By:

West Van Buren PRAP Working Group



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LIST OF ACRONYMS

1,1-DCE	1,1-dichloroethene
µg/L	micrograms per Liter
A.A.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADWR	Arizona Department of Water Resources
AFY	acre-feet per year
Air Liquide	Air Liquide USA, LLC and Air Liquide America Specialty Gases, LLC
ALSCo	American Linen Supply Company
A.R.S.	Arizona Revised Statutes
AWQS	Aquifer Water Quality Standard
bgs	below ground surface
CAP	Central Arizona Project
ChemResearch	ChemResearch Company, Inc.
COCs	Compounds of Concern
COP	City of Phoenix
COT	City of Tolleson
Dolphin	Dolphin Incorporated
ERA	Early Response Action
(ft/ft)	feet per foot
FS	Feasibility Study
GAC	granular activated carbon
gpm	gallon per minute
LAU	Lower Alluvial Unit
M52	Motorola 52nd Street Federal Superfund Site
MAU	Middle Alluvial Unit
MNA	monitored natural attenuation
NFA	No Further Action
NPV	Net Present Value
O&M	Operations and Maintenance
OU2	Operable Unit 2
PCE	tetrachloroethylene
PRAP	Proposed Remedial Action Plan
PRP	Potentially Responsible Party
Prudential	Prudential Overall Supply
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RID	Roosevelt Irrigation District
RO	remedial objective
ROD	Record of Decision

LIST OF ACRONYMS

SCM	Site Conceptual Model
SRP	Salt River Project
SVE	soil vapor extraction
TCE	trichloroethylene
UAU	Upper Alluvial Unit
VOC	Volatile organic compound
WOC	West Osborn Complex
WQARF	Water Quality Assurance Revolving Fund
WVB	West Van Buren
WVBA	West Van Buren Area
WVBWG	West Van Buren Working Group
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

This Proposed Remedial Action Plan (PRAP) has been prepared for the West Van Buren Area (WVBA) Water Quality Assurance Revolving Fund (WQARF) registry site by the West Van Buren (WVB) PRAP Working Group, a sub-group of the WVB Working Group (WVBWG). The WVB PRAP Working Group participants are the City of Phoenix (COP), Dolphin Incorporated (Dolphin), Freescale Semiconductor, Inc., Honeywell International, Inc., Prudential Overall Supply (Prudential), Salt River Project (SRP), and Univar USA Inc. (Univar).

The purpose of this document is to describe and present the proposed Preferred Remedy for the WVBA WQARF registry site for the Arizona Department of Environmental Quality's (ADEQ) consideration. The proposed Preferred Remedy in this PRAP is capable of meeting the remedial objectives (ROs) established and provided by ADEQ for the Site (ADEQ, 2012). ADEQ is required under Arizona Revised Statutes (A.R.S.) §49-287.04 to issue a PRAP for the proposed Preferred Remedy to the public for review and comment. This PRAP has been prepared in accordance with Arizona Administrative Code (A.A.C.) R18-16-408 and relies on the data and findings from the Remedial Investigation (RI) Report prepared for ADEQ by Terranext (Terranext, 2012a). The PRAP considers the preferred groundwater remedies proposed in the WVBWG Feasibility Study (FS) Report (Haley & Aldrich, 2014) and the Roosevelt Irrigation District (RID) FS Report (Synergy, 2014), and the evaluation conducted by Matrix-CALIBRE under contract to ADEQ to provide a neutral evaluation of the two FS Reports. The Matrix-CALIBRE evaluation is presented in their "Evaluation of Feasibility Studies Regarding Technical Completeness, West Van Buren Water Quality Assurance Revolving Fund" technical memorandum (Matrix-CALIBRE, 2015), which is attached as Appendix A.

2.0 BACKGROUND

The WVBA is located in the western-central portion of the COP and is approximately bounded by West McDowell Road to the north, 7th Avenue to the east, West Buckeye Road to the south, and 75th Avenue to the west. Volatile organic compounds (VOCs), including trichloroethylene (TCE) and tetrachloroethylene (PCE), were first detected in groundwater within the WVBA in 1985, during a groundwater investigation conducted by Chevron USA Inc. at its facility located south of Van Buren Street between 51st Avenue and 55th Avenue (Dames & Moore, 1985). This discovery was the inception of the WVBA WQARF site. ADEQ's November 1987 Decision Record created the Van Buren Tank Farm WQARF Area, and a December 1987 amended Decision Record changed the name to the WVBA WQARF Site (ADEQ, 2010).

Beginning in 1988, several facilities within the WVBA conducted site investigations and remedial actions under the guidance of ADEQ (Terranext, 2012a). The WVBA was placed on the State of Arizona WQARF registry in 1998 (ADEQ, 1998) and a community advisory board was formed in 1999 (ADEQ, 2010). The RI Report, which includes the Land and Water Use Report, was prepared in August 2012 by Terranext on behalf of ADEQ (Terranext, 2012b). The RI Report also includes the RO Report prepared by ADEQ *(*ADEQ, 2012).

2.1 Site Conceptual Model

A detailed Site Conceptual Model (SCM) is provided in the FS Report prepared by the WVBWG (Haley & Aldrich, 2014). The SCM provides an overview of the geology and hydrogeology of the WVBA, a description of surface waters and canals within the project area, a brief description of the facilities within the WVBA identified in the RI Report as having performed site investigations (and, in most cases, facility-specific remedial activities), a summary of the nature and extent of groundwater contamination within and adjacent to the WVBA, including impacts to groundwater from inorganic constituents resulting from historical agricultural land use, and an evaluation of the overall WVBA plume stability and concentration trends in groundwater for constituents of interest.

The main concepts of the WVBA SCM as described in the WVBWG FS Report are summarized below.

- The Upper Alluvial Unit (UAU) 1 is the uppermost aquifer, consisting primarily of coarse grained sand and gravel with some silt and clay, including occasional thin interbedded silt and clay layers. UAU1 hydraulic conductivities used in the WVBA groundwater flow model ranged from 100 to 1,000 feet per day in the upper, more permeable UAU1 to 75 to 500 feet per day in the lower UAU1 (Brown and Caldwell, 2014).

- The underlying UAU2 consists of sand and gravel with a higher percentage of silt and clay and interbedded fine-grained layers compared to the UAU1. UAU2 hydraulic conductivities used in the WVBA groundwater flow model ranged from 1 to 100 feet per day (Brown and Caldwell, 2014).

- The UAU (UAU1 and UAU2 combined) saturated thickness is approximately 200 feet.

- The UAU aquifer is generally unconfined. The current depth to the water table is approximately 100 to 150 feet below ground surface (bgs).

- Groundwater extracted from production wells within the WVBA is likely primarily derived from the UAU1, due to its prolific water-producing nature relative to the other alluvial units.

- Groundwater contamination within the WVBA is generally constrained to the UAU1 and the UAU2.

- UAU groundwater is also impacted by inorganic constituents, primarily total dissolved solids, resulting from extensive historical agricultural land use within the WVBA.

- Overall groundwater flow direction within the WVBA is from east to west at hydraulic gradients ranging from approximately 0.002 feet per foot (ft/ft) to 0.004 ft/ft in the eastern WVBA, generally flattening to 0.0005 ft/ft in the central and western WVBA.

- RID pumps approximately 75,000 acre-feet per year (AFY) for irrigation use on a seasonal basis, primarily March through September, from approximately 32 production wells located within and adjacent to the WVBA. The aggregate pumping of these irrigation wells creates a regional hydraulic trough or sink within the WVBA. Should RID irrigation pumping within the WVBA (the current and historical overarching local hydraulic control) cease, the overall groundwater flow direction would

likely shift to the northwest towards the regional pumping depression known as the Luke Sink, near the Luke Air Force Base

- Historical operations at some facilities within the WVBA have impacted groundwater. The primary Compounds of Concern (COCs) in WVBA groundwater are PCE, TCE, and to a lesser extent 1,1-dichloroethene (1,1-DCE). A localized plume of dissolved chromium is also present within the southeast portion of the WVBA.

- Facility-specific source remediation at select WVBA facilities has reduced the VOC source input at these WVBA facilities to the regional WVBA plume. At several facilities, COC concentrations within facility-specific monitoring wells have declined significantly following source remediation work, in some cases by orders of magnitude.

- Some areas of persistent, relatively elevated VOC concentrations near and/or downgradient of other WVBA facilities indicate the potential for ongoing source inputs to the regional WVBA plume in these areas.

- According to the WVBA RI Report, "Groundwater contamination enters the WVBA from the east from the Motorola 52nd Street Federal Superfund Site [M52] Operable Unit [OU] 3 area." TCE and 1,1-DCE, and to a lesser extent, PCE, are the primary COCs in the M52 OU3 plume.

- While the M52 OU3 RI/FS is currently being completed, it is assumed that the M52 Site plume has commingled with the regional plume of groundwater contamination originating from historical WVBA facility operations. Although not fully defined, the downgradient extent of the West Osborn Complex WQARF site plume, with TCE as the primary COC, also appears to have merged with the north-central portion of the WVBA plume.

- Operation of the M52 OU2 groundwater extraction system since 2001 has effectively cut off the dissolved-phase plume at the OU2/OU3 boundary, resulting in overall COC concentration declines in M52 OU3 monitoring wells and in UAU1 monitoring wells in the eastern and central portion of the WVBA.

- As a result of the WVBA facility-specific remedial work, the M52 OU2 groundwater extraction system, and irrigation pumping, the WVBA plume appears to be stable with generally declining concentration trends in the UAU1. Within the more fine-grained UAU2, VOC concentrations in UAU2 monitoring wells located along the axis of the WVBA plume have remained generally consistent over time.

2.2 Chronology of Major Site Activities

ADEQ's website lists major site activities, which are summarized below along with some recent critical milestone additions:

1987: The November 13 Decision Record created the Van Buren Tank Farm WQARF area. The amended decision record dated December 11 changed the name to WVB.

1992: In November, Univar (formerly Vopak, formerly Van Waters and Rogers Inc.) began operations of a soil vapor extraction (SVE) system.

1994: ChemResearch Company, Inc. (ChemResearch) entered into a Resource Conservation and Recovery Act (RCRA) Consent Order with ADEQ.

1996: On September 20, Univar entered into Consent Order W-109-96 with ADEQ.

1997: Maricopa County began SVE system operation. After 6 months of operation, soil contaminant levels were reduced below the regulatory standards. In May, American Linen Supply Company (ALSCo), located at 720 W. Buchanan Street, settled with ADEQ for $2 million dollars.

1998: In April, WVB was placed on the WQARF Registry with an Eligibility and Evaluation score of 50 out of a possible 120. In October, Dolphin, located at 740 S. 59th Avenue, began operation of SVE and air sparge systems at their facility.

2000: In 2000, Reynolds Metals (now ALCOA), located between 35th Avenue and 43rd Avenue and West Van Buren Street and the Southern Pacific Railroad right-of-way, excavated and removed contaminated soil from their site and received a No Further Action (NFA) for soils in specific areas from ADEQ. In January, Dolphin entered into RCRA Consent Order Z-2-00. Consent Judgment CV 2000-001824 was filed.

2001: In March, ADEQ/ALSCo began an Early Response Action (ERA) utilizing SVE, air sparge and groundwater pump and treat systems. Union Pacific Railroad Company and Maricopa County settled with ADEQ for $450,000.

2002: In June, Reynolds/ALCOA settled with ADEQ for $1.96 million. In August, Univar received a NFA determination for soil from ADEQ and the Univar Consent Order W-109-96 was terminated by ADEQ. By October, the ALSCo SVE system had removed over 900 pounds of VOCs from the soil and the system operation was ceased. In December, Dolphin ceased remedial system operation and conducted rebound testing.

2003: The ALSCo ERA groundwater pump and treat system ceased operation in September after treating approximately 118 million gallons of groundwater.

2004: In April, Dolphin completed rebound testing and received ADEQ authorization for SVE system shut down.

2006: In September, ADEQ installed seven monitoring wells and sampled 125 groundwater monitoring wells as part of the semi-annual sampling process. Dolphin satisfied the Consent Order and Consent Judgment, which were closed on June 6.

2007: A new Land and Water Use Questionnaire was sent to stakeholders to update the Land and Water Use Study completed in October 2001. In June, ADEQ completed installation of six groundwater monitoring wells. Air Liquide USA, LLC and Air Liquide America Specialty Gases, LLC (Air Liquide) signed a Consent Order to continue conducting investigation work on their property.

2008: Three monitoring wells were installed by ADEQ to help delineate the extent of the groundwater plume and to further investigate potential source areas. Air Liquide completed the installation of four groundwater monitoring wells and conducted quarterly groundwater sampling. Prudential signed a Consent Order to continue investigating soil and groundwater at their facility. Prudential also conducted a passive soil gas survey at their facility in May and June and installed three groundwater monitoring wells in July. Water levels were measured monthly and groundwater samples were collected in August and September.

2009: Air Liquide and Prudential continued to do work under consent orders. ADEQ solicited comments for the ROs of WVB. ADEQ signed a working agreement with RID to review its regional groundwater ERA proposal.

2010: Groundwater monitoring and sampling was conducted in June and September. Groundwater sampling of RID wells and surface sampling of RID canals was also conducted in June. Prudential performed a pilot test to determine if SVE would be suitable for soil remediation. ADEQ conditionally approved RID's ERA on June 24.

2011: Groundwater monitoring and sampling was conducted in March and September. Groundwater sampling of RID wells and surface sampling of RID canals was also conducted in April and September. Prudential began installation of a SVE system to remediate soils beneath the facility. RID began a pilot test at well RID-95 to observe and study the use of granular activated carbon (GAC) in treating VOCs in groundwater.

2012: Groundwater monitoring and sampling was conducted in March and September. Air Liquide finalized a SVE pilot test work plan in March and conducted testing in June. The RI was completed for WVB in August. RID submitted a modified ERA in October.

2012: ADEQ issued the WVB RI Report and the ROs (Terranext 2012a).

2013: Groundwater monitoring and sampling was conducted in March and September. Groundwater sampling of RID wells and surface sampling of RID canals was conducted in April and September. ADEQ conditionally approved RID's modified ERA on February 1. Prudential began operation of a SVE system in December to remediate soils beneath the facility. ADEQ signed a working agreement with the WVBWG to review their regional FS Work Plan and RID submitted a separate regional FS Work Plan for approval. RID and the WVBWG began conducting two separate FSs. Penn Racquet Sports, Inc., (Penn), located at 306 South 45th Avenue, settled with ADEQ for $30,000 dollars under Consent Decree 13-01631.

2014: Groundwater monitoring and sampling was conducted in March. Groundwater sampling of RID wells and surface sampling of RID canals was conducted in March. Three new monitoring wells were

installed by ADEQ to help delineate the extent of the groundwater contamination and to investigate potential source areas. Air Liquide continued to monitor groundwater conditions beneath its facility. Prudential continued to operate its SVE system and monitor groundwater conditions below its facility. The operations and maintenance (O&M) manual for RID's modified ERA was put out for public comment in June. The WVBWG (Haley & Aldrich, 2014) and RID (Synergy, 2014) submitted individual regional FS reports for the WVBA to ADEQ in July.

2015: The Arizona Department of Health Services (ADHS) prepared a Health Consultation evaluating the potential human health risk to exposure to RID well water and to RID canal water.

2015: ADEQ issued letters to both the WVBWG and RID regarding the draft feasibility studies in April (ADEQ, 2015a and 2015b).

2015: ADEQ received the "Evaluation of Feasibility Studies Regarding Technical Completeness, West Van Buren Water Quality Assurance Revolving Fund (WQARF) Site" technical memorandum from their consultant, Matrix-CALIBRE, in July (Matrix-CALIBRE, 2015).

2.3 A.R.S. §49-287.04(C) Notice

The WVBA RI Report discusses numerous WVBA facilities that may have contributed to the groundwater plume. WVBA facilities identified in the RI Report as having conducted site investigations and, in most cases, remedial activities, include the following:

- Air Liquide;
- ALSCo;
- ChemResearch;
- Department of Energy;
- Dolphin;
- Maricopa County Materials Management;

- Prudential;
- Reynolds Metals Co.; and
- Van Waters & Rogers (now Univar USA Inc.).

Many more WVBA facilities identified in the RI Report, as well as other potential sources in the WVBA have not yet conducted site investigations. ADEQ's Potentially Responsible Party (PRP) search for the WVBA, including orphan sites, is ongoing. The WVB PRAP Working Group is preparing a preliminary list of orphans for notice under A.R.S. §49-287.04(C) as a separate filing.

3.0 FEASIBILITY STUDY PROPOSED REMEDIES

Separate FS reports were prepared for the WVBA WQARF registry site by the WVBWG (Haley & Aldrich 2014) and by RID (Synergy, 2014) in 2014. On April 13, 2015, ADEQ issued letters to the WVBWG (ADEQ, 2015a) and RID (ADEQ, 2015b) that both stated, "ADEQ has determined that the FS Report meets the requirements of Arizona Revised Statutes 49-287.03 and Arizona Administrative Code R18-16-407 and therefore ADEQ is approving the…FS Report. Please be aware though, that because competing State-wide budget priorities have resulted in the continued underfunding of WQARF, ADEQ will be discontinuing all discretionary work on the WVB WQARF site at this time. Should funding levels change, ADEQ will of course re-evaluate this decision." On July 28, 2015, ADEQ received from its consultant, Matrix-CALIBRE, a technical memorandum entitled, "Evaluation of Feasibility Studies Regarding Technical Completeness, West Van Buren Water Quality Assurance Revolving Fund (WQARF) Site" (hereafter referred to as the Matrix Report) that "summarizes the technical completeness review of the two Feasibility Studies." (Matrix-CALIBRE, 2015). Accordingly, this PRAP presents the Preferred Remedy for ADEQ's consideration based on evaluating the proposed remedies from each FS, and incorporating comments from the Matrix Report. The separate proposed remedies are described in detail in the two FS reports (Haley & Aldrich, 2014 and Synergy, 2014), with the key elements of each summarized below.

3.1 WVBWG Proposed Remedy

The WVBWG FS Report identified its "Reference Remedy" as the proposed groundwater remedy for the WVBA. As described in the FS, the WVBWG proposed remedy included the following base elements: 1) continued groundwater monitoring as part of a monitored natural attenuation (MNA) remedy; 2) completing an expanded private well inventory in an area adjacent to the WVBA. Although no private wells impacted by contamination from the WVBA are known to exist, for costing purposes it was assumed that five private wells would be replaced by a connection to the COP municipal supply; 3) focused plume core extraction with a new 500 gallon per minute (gpm) extraction well near 35th Avenue to potentially reduce the risk for implementing future contingent measures in 2026 when RID's pumping ceases. Although safe for its intended use without treatment, due to RID's policy regarding third-party discharges to its system, the extracted water would have to be treated prior to discharge to the RID Main canal for beneficial re-use as an irrigation water supply. As described in detail in the WVBWG FS,

and as discussed further below, in addition to the base remedy elements, the WVBWG proposed remedy also identified a number of contingent measures with triggers, one or more of which may be implemented in the future, if needed, based on Site conditions.

3.1.1 Matrix-CALIBRE Review of the WVBWG Proposed Remedy

Matrix-CALIBRE, on behalf of ADEQ, reviewed the WVBWG proposed remedy and deemed it technically complete. The Matrix Report agreed with the overall SCM and technical practicability of the WVBWG proposed remedy, with some comments directed at the reasonableness of the proposed additional 500 gpm extraction well at the start of the remedy. For example, as stated in Table 3 of the Matrix Report, "Current risks are within acceptable thresholds for present use, remedial actions taken would not lower current risks by an appreciable amount." The Matrix Report also noted that, "Contingency remedial actions are planned that would lower risk if resource is used for potable supply in the future." (Table 3, page 1 of 8). With the exception of a specific element of the WVBWG proposed remedy discussed below, the overall finding of the Matrix Report was that, "The [WVBWG] recommended remedy is protective of public health and the environment; it provides for practicable control, management or cleanup of the hazardous substances to allow the maximum beneficial use of the waters of the state; and is reasonable, necessary, cost-effective, and technically feasible." (Table 3, page 2 of 8).

In regard to A.R.S. § 49-282.06(C)(1-2), which addresses the factors that the [ADEQ] Director shall consider in evaluating a proposed remedy, such as population, environmental, and welfare concerns at risk, and routes of exposure, the Matrix Report determined that for the WVBWG proposed remedy, "Presently, levels are not above risk thresholds (ADHS, 2015); future changes in groundwater use and corresponding risk are addressed." In regard to A.R.S. § 49-282.06(C)(3), which addresses the amount, concentration, hazardous properties, environmental fate, persistence, and probability of contaminants reaching the waters of the state, and the form of the substance present, the Matrix Report determined that, "Most of the plume [which is noted as already being in the 'waters of the state'] is at concentrations near the AWQSs [Aquifer Water Quality Standards] for PCE and TCE," and that, "Limited areas have higher concentrations (more than 4 times the AWQSs)." As explained in the WVBWG FS, these "limited" areas are accounted for via contingencies in the proposed remedy should they be necessary at the time of planned implementation.

In addition to explaining that the WVBWG proposed remedy is reasonable and necessary for the WVBA, the Matrix Report also determined the proposed additional extraction well pumping at 500 gpm at the start of the remedy was "not reasonable" because it "does not appreciably improve current mass removal…" (Table 3, page 1 of 8). On a regional scale, the substantial volume of groundwater currently being pumped by the RID irrigation network represents the primary hydraulic influence on groundwater within the WVBA, already removes mass from the subsurface, and results in overall hydraulic containment of the current WVBA plume (Haley & Aldrich, 2014). Whether that extracted groundwater is treated at the surface or not does not change the fact that this dissolved-phase mass is already being removed from the subsurface by pumping for its intended use. Because of Matrix's determination, the WVB PRAP Working Group re-evaluated the timeline for installation of this well, and now includes it in the Preferred Remedy as a primary contingency for future consideration, if needed. This contingent measure would be necessary, if, for example, future long-term groundwater pumpage from nearby cities overwhelm RID irrigation pumpage, which could result in reduced hydraulic containment of the plume in the WVBA and potential impact to downgradient wells (City of Tolleson [COT] and SRP). Details of this evaluation are presented in Section 4.0.

3.1.2 Statement from the Water Provider Members of the WVB PRAP Working Group (COP and SRP) Regarding the Utility of the 500 GPM Extraction Well

The water provider members of the WVB PRAP Working Group (COP and SRP) believe it is important to clarify that although the Matrix Report concluded the 500 gpm well was "not reasonable" from a mass removal standpoint, the overall purpose for this well was to provide a proactive approach through additional control of plume migration in the highest concentration area until 2026, thereby reducing downgradient concentrations and the potential need to implement contingencies in the future at downgradient supply wells. The WVBWG FS modeling results show that the 500 gpm extraction well, pumping simultaneously with RID-95, would improve capture of the COC mass flux at 35th Avenue (Haley & Aldrich, 2014). The water providers also believe the 500 gpm extraction well helps, in part, to address the Matrix Report's other criticism of the WVBWG FS proposed remedy; namely that some elements of the remedy may not be a robust solution if/when RID ceases pumping, including: 1) allowing the plume to migrate to downgradient COT/SRP wells; and 2) plume projections in 2026 may be 'optimistic' based on current attenuation rates. The WVBWG FS Report indicates VOC concentrations in the UAU2 plume

core are stable or increasing. The water providers continue to see the utility in this additional extraction well sooner rather than later in order to be protective of other downgradient production wells (COT and SRP), especially when the RID contract expires and ceases pumping no later than 2026.

3.2 RID Proposed Remedy

The RID FS Report identified its "Less Aggressive Remedy" as RID's proposed groundwater remedy for the WVBA. As described in the RID FS, which was mirrored in its Draft PRAP, the RID proposed remedy included the following key elements: 1) installing well head treatment at six RID wells (including the four wells where treatment units are already in place) and adjusting some of the pumping rates at these wells; 2) blending of six additional RID wells where VOCs have been observed; 3) replacing one RID well with a well with increased capacity; and 4) increasing the size of the pump and motor at one existing RID well to increase capacity (Synergy, 2014). Discharged water from the RID proposed remedy would be placed in the RID canal, including the canal containing treated wastewater effluent, and used for irrigation supplies for at least the near future as the required financing, legislative changes, legal decisions, permits, contracts, and infrastructure necessary to provide potable water from RID's wells are serious obstacles to overcome. RID identified one contingent measure of injecting reclaimed wastewater into its identified replacement well on a seasonal basis (Synergy, 2014). No remedial measures or contingent measures were identified for other water providers, including the COP and SRP, in the vicinity of the WVBA.

3.2.1 Comments on the RID Proposed Remedy

Extensive comments on the RID FS were prepared by the WVBWG (Gaylord, 2014). Numerous issues and errors in the RID FS were identified in these comments, the most significant of which are: 1) there is no current risk to public health that needs to be addressed by RID's "remedy;" 2) the water produced from the RID wells is fit for its current use without treatment; and 3) the RID proposed remedy fails to meet, or even consider, the ROs of other water providers in the vicinity of the WVBA, including the conservation of water in the SRP and COP use areas (Gaylord, 2014).

To focus more on these first two comments, the absence of current risk to the public health and the fitness of water extracted from RID wells for its current use without treatment were verified by the

ADHS which, in 2015, completed a Health Risk Consultation on the RID wells and canals. ADHS concluded that exposure to TCE, PCE, and 1,1-DCE concentrations in RID well RID-84 without any treatment would not be expected to harm people's health under typical conditions of household water use (e.g. drinking, cooking, bathing, washing clothes and dishes, brushing teeth, gardening) (ADHS, 2015). ADHS further concluded that ingestion exposure to TCE and PCE in groundwater and canal water in the RID sampling area (29 RID irrigation wells and the RID canal) is not expected to harm people's health (ADHS, 2015). The ADHS conclusion is supported by several prior health risk evaluations, which reached similar conclusions. RID confirmed that there is no current risk to the public health and the RID wells are fit for current use without treatment by operating wells RID-89, RID-92, RID-95, and RID-114 in bypass mode (circumventing the treatment units installed at those wellheads) in the latter portion (August and September) of the 2013 RID high pumping season and the 2014 high pumping season (May through September). ADEQ allowed RID to operate these wells in bypass mode without the need for treatment. RID does not own or operate the wellhead treatment systems, but the operator of the systems also removed Receiver Box Breathers (to control VOC emissions) from the wellheads because air samples at these boxes were similar to normal/background ambient air quality. This is shown through a comparison of the RID O&M Plan dated October 2013 (Revision 3, pp. 12-13; Synergy, 2013) and the RID O&M Plan dated May 3, 2012 (Revision 2, page 15; Synergy, 2012).

3.2.2 Matrix-CALIBRE Review of the RID Proposed Remedy

Matrix-CALIBRE, on behalf of ADEQ, also reviewed the RID proposed remedy and similarly deemed it technically complete. The Matrix Report determined, however, that the RID proposed remedy was not reasonable, necessary, or cost effective. In the table of WQARF remedy requirements, the Matrix Report left blank the requirement that the proposed remedy is "reasonable, necessary, cost-effective, and technically feasible." (Table 2, page 2 of 8). In the text of that table, the Matrix Report states as to the nonexistence of risk and unreasonableness of any current remedial action that, "Current risks are within acceptable thresholds for present use, remedial actions taken would not lower risk by an appreciable amount" and, "Remedial actions are not required for current use therefore they are not reasonable at this time…" (Table 2, page 1 of 8). The Matrix Report also determined that the RID proposed remedy is, "Not necessary until such time as future use of the resource is for potable supply; includes elements targeted more for water supply development rather than remediation." (Table 2, page 1 of 8). The

Matrix Report also noted with respect to RID's proposed remedy that, "The remedial action removes the groundwater resource from the current water basin." (Table 2, page 3 of 8). RID's proposal is designed to facilitate it's attorneys', consultants', and investors' development plans to become a potable water supplier despite issues raised by other water providers: "The FS presents remedial actions that are consistent with RID's development plans. Other water providers and local governments have raised issues regarding RID's plans in the public comments." (Table 2, page 5 of 8). The Matrix Report also identified flaws in RID's risk evaluation, noting that the evaluation was based on "…historical conditions (without historical exposure estimates) rather than current resource use and exposure pathways." (Table 2, page 6 of 8).

Given these fundamental deficiencies of the RID proposed remedy, as well as the numerous other issues with RID's proposed remedy documented to ADEQ, the RID proposed remedy is not considered to be reasonable, necessary, or cost effective and was, therefore, rejected for consideration in the WVBA.

In summary, the findings presented in the Matrix Report are that current risks are acceptable and RID's proposed remedial actions are not reasonable, necessary, or cost effective. Further, the Matrix Report concludes that RID's proposed remedy fails to meet certain ROs because elements of RID's proposed remedy are geared towards RID's development plans, and those plans export water from the current groundwater basin, inconsistent with the objectives of other water providers and local governments in the WVBA. In accordance with these findings, there are no components of the RID proposed remedy that will be incorporated into the Preferred Remedy identified in this PRAP.

4.0 PREFERRED REMEDY

Based on review of the RID FS and comments provided in the Matrix Report, the Preferred Remedy for ADEQ's consideration for the WVBA is a modified version of the WVBWG Reference Remedy that moves the proposed extraction well at 500 gpm from a base component to a primary contingency. The Preferred Remedy also includes more frequent hydrogeologic evaluations as a base component to determine if contingencies are needed at that time.

4.1 Observations and Assumptions

The Preferred Remedy is based on the following primary observations and assumptions used during the development of the various remedial alternatives:

- Regional irrigation pumping has a significant influence on overall water levels, hydraulic gradients, and groundwater flow directions within the WVBA.
- Facility-specific remedial work within the WVBA has resulted in declining source inputs to the WVBA regional plume; ADEQ will continue to implement source control measures.
- The M52 OU2 groundwater extraction system has contained the VOC mass flux at the OU2 boundary.
- VOC concentrations in UAU1 regional groundwater have generally been on the decline.
- The overall lateral extent of the WVBA plume has either decreased or remained stable, depending on the area.
- The West Osborn Complex implements its WQARF remedy that addresses continuing migration of VOCs into the north-central portion of the WVBA.
- RID irrigation pumping will continue at existing rates until 2026.

4.2 Preferred Remedy

The Preferred Remedy incorporates, as all groundwater remedies must, the existing and ongoing hydraulic controls (due to ongoing RID irrigation pumping) within the area to be addressed, along with an evaluation of the actual risk associated with the subsurface impacts. The Preferred Remedy is consistent with the neutral evaluation presented in the Matrix Report by modifying it to make installation of the 500 gpm extraction well a primary contingent measure subject to periodic hydrogeologic evaluations, as described below. As modified, the Preferred Remedy provides the most reasonable, necessary, cost-effective, and technically feasible remedial alternative to address the groundwater plume in the WVBA considering that until 2026, ongoing RID irrigation pumping is maintaining hydraulic control of the plume.

The Preferred Remedy relies on an enhanced groundwater monitoring program, MNA, hydrogeological evaluations, and more contingent remedial measures in the event that wells (public or private) located within or outside of the WVBA are threatened to be rendered unfit for their current and reasonably foreseeable end uses as a result of migration of groundwater contamination within or from the WVBA.

The Preferred Remedy includes the following components:

***Base Components (assumes RID is pumping at current volumes)*:**

- Groundwater monitoring program.
- Although no impacted private wells have been identified, for costing purposes provides for the connection of five private wells within the WVBA to the COP municipal system.
- Conduct of a hydrogeological evaluation beginning in 2019, and every 3 years thereafter through 2025, to determine the benefits of focused groundwater extraction with a 500 gpm plume core extraction well, treatment, and subsequent reinjection of the extracted water into the Lower Alluvial Unit (LAU). The hydrogeologic evaluation would evaluate existing groundwater data and calculate projected COC mass removal (if any) based upon a trend analysis of the most recent (at the time) water quality data. It may also include use of a groundwater model to determine if the pumping would have beneficial impacts on protecting current or future downgradient production

wells. The detailed hydrogeological evaluation could also assess alternative remedial technologies if available. The hydrogeologic evaluation would be reviewed by ADEQ, the COP and SRP, and other involved WVBWG members to determine if contingencies are needed at that time.

***Potential Contingencies after 2025 (assumes RID ceases groundwater pumping)*:**

The potential contingent measures that have been identified include:

- Conduct of a hydrogeologic evaluation for the need to install one 500 gpm plume core extraction well if one had not been previously installed, or continue, expand, or terminate operation of the well if one had been previously installed, beyond 2025. The hydrogeologic evaluation would evaluate existing groundwater data and calculate projected COC mass removal (if any) based upon a trend analysis of the most recent (at the time) water quality data. It may also include use of a groundwater model to determine if the pumping would have beneficial impacts on protecting current or future downgradient production wells. The detailed hydrogeological evaluation could also assess alternative remedial technologies if available. The hydrogeologic evaluation would be reviewed by ADEQ, the COP and SRP, and other involved WVBWG members to determine if contingencies are needed at that time.

- Conduct of a hydrogeologic evaluation for the need to install an additional 1,000 gpm extraction well in an area most beneficial to addressing any remaining COC mass that has the potential to impact current and future downgradient production wells. The primary goal of this contingent remedial action would be to reduce (if needed) the potential future risk of impairing SRP, COP, and other production wells. The detailed hydrogeological evaluation would assess alternative remedial technologies if available and calculate projected COC mass removal (if any) by the 1,000 gpm extraction well based upon a trend analysis of the most recent (at the time) water quality data from wells within the plume. A groundwater model may be used to evaluate if the extra pumping will have an additional beneficial impact on capture of upgradient COC impacted groundwater and protecting current or future downgradient extraction wells, and to evaluate the potential impact to current and future production wells if no additional contingent remedial actions are conducted. Replacing up to two SRP wells (with or without any additional groundwater pumping) and other

appropriate alternative contingent actions should any be deemed necessary at the appropriate time would also be evaluated. The hydrogeologic evaluation would be reviewed by ADEQ, the COP and SRP, and other involved WVBWG members to determine if contingencies are needed at that time.

- Drill and construct up to nine new sentinel monitoring wells if groundwater flow directions change in response to reduced or eliminated RID irrigation pumping.

- An allowance for conducting quarterly monitoring at up to sixteen monitoring wells and eleven SRP wells based on future groundwater flow conditions.

- An allowance to connect up to five private wells outside the WVBA to the COP municipal system if groundwater flow directions change in response to reduced or eliminated RID irrigation pumping and such wells exist and are threatened by any remaining impacted groundwater.

- An allowance to replace RID-114 with a new UAU production well at a different location to be determined based on need and the regional hydraulics at that time.

4.3 Estimated Remedial Action Costs

Consistent with the WVBWG FS and R18-16-407(H)(3)(c), the estimated cost of the Preferred Remedy includes expenses and losses, including capital, operating, maintenance, and life cycle costs. The estimated cost for the Preferred Remedy is presented for both the base components and contingencies, with the understanding that it is unlikely that all contingencies listed may be necessary in the future. A discount rate of 6 percent was used to calculate the Net Present Value (NPV) for O&M and capital costs required beyond the year one of the remedy. NPV analysis is the standard method accepted by established guidance for conducting FSs to evaluate both capital and O&M expenditures that are expected to occur over time. EPA guidance notes that while non-discounted constant dollar values can

be provided for illustrative purposes, they should not be used in place of NPV costs in selecting remedies (EPA, 2000).[1]

The Preferred Remedy base components total NPV cost is estimated at $3.28M ($10.35M non-discounted with 3 percent inflation rate). The estimated NPV costs for the Preferred Remedy individual contingencies described above range from $0.02M to $5.10M ($0.07M to $28.10M non-discounted with 3 percent inflation rate). The total NPV for all Preferred Remedy contingencies, should the unlikely event occur that all contingencies are required for the full remedy period is approximately $15.96M, including $8.40M capital and $7.56M O&M expenses. Consistent with R18-16-407(H)(3)(c), it is reasonable to assume that less than 50 percent of the identified contingent costs would require implementation.

Table 1. Preferred Remedy Remedial Action Costs

	NPV at 6 percent Discount Rate*	Non-discounted with 3 percent Inflation*
Base Components	$3.28	$10.35
Contingencies (sum of all)	$0.02 to $5.10 ($15.96)	$0.07 to $28.10 ($72.53)
Total Estimated Cost (including all contingencies)	$19.24	$82.88

*All dollars in millions

There is a significant cost savings in investing today's dollars for future contingent actions. As such, when evaluating total costs for the Preferred Remedy, one does not look at the total cost today (non-discounted cost) because that overestimates the amount of money needed for an action to be implemented years in the future. That is the reason why remedial action costs are always presented in NPV terms. At a NPV value cost of <$20 million, the Preferred Remedy presented in this PRAP meets the ROs. Under WQARF, ADEQ is responsible for the shares of orphan parties who contributed to the plume. In other words, ADEQ is responsible for protecting the State's resources from being spent on remedies

[1] The Matrix Report presented the total cost for the WVBWG Reference Remedy in current dollars, without converting these costs to NPV. As noted in the text, NPV cost is the appropriate cost to consider in selecting remedies. Consistent with Matrix-CALIBRE'S determinations, the Preferred Remedy relies primarily on contingent future actions (if needed), so showing the NPV cost also documents for the public relative cost savings associated with investing remedial dollars over time.

that are not cost effective, reasonable, or necessary. The Preferred Remedy as modified is cost-effective, reasonable, and necessary and represents a significant cost savings to Arizona taxpayers.

4.4 Achievement of Remedial Objectives

In 2012, ADEQ established WVBA ROs for impacted or threatened land and water in terms of current and reasonably foreseeable land use and current and reasonably foreseeable beneficial uses of the waters of the state [(R18-16-406(D) and (I)]. Reasonably foreseeable land uses are those uses of land likely to occur at the Site. Reasonably foreseeable water uses are those likely to occur within 100 years unless a longer time period is shown to be reasonable based on site-specific information.

ADEQ's ROs for the WVBA were based on the 2012 Land and Water Use Report that contains descriptions of current and reasonably foreseeable land use for the COP and COT, and current and reasonably foreseeable use of water for the COP, COT, SRP, RID, and private wells within the WVBA (Terranext, 2012a).

The WVBWG consulted with the area water providers to obtain additional information to develop remedial measures. As part of a October 2, 2013 meeting between the WVBWG's consultant Haley & Aldrich and local water providers, the COP, SRP, and RID provided additional information regarding their current and reasonably foreseeable future use of groundwater within and adjacent to the WVBA (Haley & Aldrich, 2014). Information on the proposed future COT production wells was provided by COT's Supervisor of Water Utilities (COT, 2014).

The ROs for each impacted or threatened land and water use and the methods by which the ROs would be achieved by the Preferred Remedy are listed in the following.

4.4.1 Remedial Objectives for Land Use

The ROs for land use in the WVBA are:

- "Protect against possible exposure to hazardous substances in surface and subsurface soils that could occur during development of property based upon applicable zoning regulations";

- "Protect against possible leaching of hazardous substances in surface and subsurface soils to the groundwater"; and

- "Protect against the loss or impairment of current and all reasonably foreseeable future uses of land as provided in zoning regulations and the Land and Water Use report as a result of hazardous substances in surface and subsurface soils. Appropriate remedial actions will be implemented as an Early Response Action (ERA) or after the record of decision (ROD) is finalized, whichever is warranted and continued until hazardous substances causing the impairment or restriction to the land use are remediated."

The WVBA is located within the COP and abuts the COT's eastern boundary at 75th Avenue. Current and future land use is provided in the COP's General Plan, which includes the goals, policies, and recommendations for land use development during the next 10 to 20+ years. In 2000, the highest percentages of land use for the COT were agriculture (46 percent); industrial/warehouse (24 percent); and residential (14 percent). Land use in the eastern portion of the COT, adjacent to the WVBA, is primarily agriculture and industrial (Terranext, 2012b). Land use within a portion of the WVBA and adjacent areas has been transitioning from irrigated agricultural lands to more urbanized municipal uses (residential and industrial) and that trend is expected to continue into the future.

Mitigating or eliminating facility-specific source areas is critical to addressing any potential exposure to hazardous substances, protecting against possible leaching of hazardous substances in surface and subsurface soils to the groundwater, and protecting against the loss or impairment of current and all reasonably foreseeable future uses of land. Without addressing ongoing sources, the regional plume will likely persist. Facility-specific remedial work within the WVBA has resulted in declining source inputs to land and water. Some facilities within the WVBA have performed remedial work and as a result, VOC concentrations in soils have been reduced to concentrations below applicable standards and COC concentrations in facility-specific groundwater monitoring wells have been reduced. The effect of this work has reduced VOC source inputs in soils and the WVBA regional plume, resulting, in part, in overall declining VOC concentration trends.

The Preferred Remedy assumes that additional facility-specific source work, to the extent any is necessary, will be completed under ADEQ guidance separate from the Preferred Remedy, and ADEQ has confirmed its intention to continue to work to identify and address any facility sources in the WVBA.

4.4.2 Remedial Objectives for Groundwater Use

ADEQ's RO report included ROs for municipal, agricultural, and private uses of groundwater.

Municipal Groundwater Use: The ROs for current and reasonably foreseeable future municipal groundwater use in and near the WVBA are:

- "To protect, restore, replace or otherwise provide a water supply for municipal use by currently and reasonably foreseeable future municipal well owners within the WVBA WQARF site if the current and reasonably foreseeable future uses are impaired or lost due to contamination from the site. Remedial actions will be in place for as long as need for the water exists, the resource remains available and the contamination associated with the WVBA WQARF site prohibits or limits groundwater use. Remedial actions to meet ROs will be implemented upon issuance of the ROD. If there is an imminent risk to human health or the environment, then an ERA may be initiated prior to implementation of the ROD."

- "To protect, restore, replace or otherwise provide a water supply for municipal groundwater use by currently and reasonably foreseeable future municipal well owners outside the current plume boundaries of the WVBA WQARF site if the current and reasonably foreseeable future uses are impaired or lost due to contamination from the site. Remedial actions will be in place for as long as need for the water exists, the resource remains available and the contamination associated with the WVBA WQARF site prohibits or limits groundwater use. Remedial actions to meet ROs will be implemented upon issuance of the ROD. If there is an imminent risk to human health or the environment, then an ERA may be initiated prior to implementation of the ROD."

COP: The COP has no wells within the WVBA that are either supplying water or are part of the COP's water system, and no existing COP production wells with anticipated production within the next 30 years are located northwest of the WVBA, should regional irrigation pumping cease and the overall

groundwater flow direction shift to a more northwest flow direction. While the COP does not have specific plans for groundwater wells within the WVBA today, the COP states in its 2011 Groundwater Management Plan, "With regard to remediation of contaminated groundwater within Phoenix's service area, it has been the City's stated intent to preserve that water for future service area use." The COP's Groundwater Management Plan envisions groundwater within the WVBA will someday be a necessary component of the COP's drought supply, and that the SRP is likely to serve a role in delivering the groundwater.

COT: The COT has no wells within the WVBA that are either supplying water or are part of the COT's water system. The COT has four production wells located west of the WVBA that are mainly used in the summer months as a backup supply (COT, 2005). The COT also intends to drill and construct five new production wells over the next 3 to 10 years (COT, 2014). Based on the WVBWG FS groundwater modeling results, none of the existing or proposed future COT production wells would likely become impaired under the Preferred Remedy (Haley & Aldrich, 2014). However, to reduce uncertainty, consultation with the COT is suggested regarding the proposed location of future wells.

RID: RID operates 32 groundwater production wells within or adjacent to the WVBA. These wells are not impaired today, as they are currently fit for their current irrigation end use without the need for treatment of COCs (ADHS, 2015; Haley & Aldrich, 2014). The ROs establish future drinking water use as reasonably foreseeable. If changes of end use occur before declining contaminant levels render the water fit for drinking water use without the need for treatment of COCs, and RID is able to obtain legal authorization to deliver water to third-party drinking water providers for potable use, strategies or measures will be needed to provide for the new use.

Regarding reasonably foreseeable water uses, the November 12, 2007 Land and Water Use Report questionnaire completed by RID (RID, 2007) stated that RID's current water use is "for non-potable purposes within the District's boundaries" and RID's future water use of wells, canals, and laterals for the foreseeable future "will continue to be used much as they are today." The RID questionnaire also stated the future use (up to 100 years) for any RID well impacted by the WVBA plume would be, "Same as today." RID submitted a revised questionnaire to ADEQ dated January 12, 2010 (RID, 2010) which stated that "Currently, the wells in the WVB site provide water supply for irrigation but the wells will

transition to drinking water supply as residential and commercial development continues in the District." The revised questionnaire did not explain the legal mechanism or timing of this proposed transition. RID clarified in its response to the water provider questionnaire that it does not intend to itself become a potable water provider or provide direct delivery of potable water to its own customers.

RID has proposed sale of its water supply to water providers outside the WVBA. RID proposed that the water would serve as a raw water supply for drinking water end uses by the purchasers' customers (RID, 2010). The Arizona Department of Water Resources (ADWR) has expressed concern about RID's authority to move groundwater from within the boundaries of a water provider that has obtained a Designation of Assured Water Supply (in this case, the COP) and the potential to negatively affect that Designation (ADWR, 2010). Others have raised additional concerns regarding RID's authority to move groundwater from within the WVBA in the future (SRP, 2011; Gaylord, 2011). These legal issues have not yet been resolved.

SRP: SRP has several groundwater production wells near the WVBA, although none of them are located within the WVBA boundaries. To date, SRP's use of these wells has not been impacted by the WVBA groundwater plume. As a result of changing land use in the area, SRP anticipates that some SRP wells will eventually transition to a drinking water use in the reasonably foreseeable future, either by directly connecting the wells to municipal distribution systems within the Salt River Reservoir District (SRRD), or piping to municipal water treatment plants located on the SRP canal system as a drought supply (SRP, 2011).

With ADEQ-directed source control measures and continued RID groundwater extraction, contaminant concentrations in groundwater will continue to decrease over time and could fall below the AWQS before future potable water uses become viable (Haley & Aldrich, 2014).

Extensive groundwater monitoring within the WVBA will provide the basis for determining which, if any, proposed contingent remedial measures will be implemented. The proposed monitoring program will include the sampling of the existing monitoring network of 68 UAU1, 27 UAU2, and 6 Middle Alluvial Unit (MAU) monitoring wells for COC analysis, and total chromium and filtered total chromium analyses at select wells. A subset of monitoring wells within the interior of the plume would also be sampled and

analyzed for MNA parameters annually. Water level elevation measurements would be taken from approximately 120 monitoring wells semiannually.

If the existing monitoring program was determined to be inadequate should RID stop pumping in 2026 and groundwater flow direction in the WVBA system changes, seven existing UAU1 monitoring wells located along the northern and western perimeter of the WVBA, along with five new sentinel wells located to the west-northwest of the WVBA, would be sampled and analyzed for COCs quarterly for the first year and then at an appropriate frequency thereafter. If operating, the eleven SRP wells located west and northwest of the WVBA, will also be sampled and analyzed for COCs during the sentinel monitoring events.

In addition to the planned evaluations included in the Preferred Remedy base components, if routine groundwater monitoring indicates a significant change to hydraulic and/or water quality conditions (i.e., COC concentrations increase significantly, groundwater flow directions change significantly, and/or plume migration is more rapid than predicted), further hydrogeologic evaluations would be conducted to assess the need for changes to the existing monitoring well network. These would include additional model simulations to determine if the changes in hydraulic and/or water quality conditions would have negative impacts on planned remedial actions and downgradient users, and if additional, unplanned remedial activities are warranted. Remedial activities that may be considered in this analysis include more frequent monitoring and installing a more enhanced monitoring network.

The monitoring program will provide data on: (1) the nature and extent of the WVBA plume; (2) the overall stability of the plume's lateral and vertical extent; (3) COC concentration trends over time; and (4) intrinsic MNA processes within the UAU aquifer. Water level elevation data would also be used to evaluate seasonal hydraulic gradients, long-term water level elevation trends, and aquifer response to changes in regional pumping conditions. The overall stability of the UAU2 plume extent over time would also be further evaluated using data from UAU2 monitoring wells.

The hydrogeologic evaluation conducted at the end of 2025 in accordance with Section 4.2 of this PRAP would be used to determine, based upon the 2025 water level elevation and water quality conditions within the WVBA plume, if proposed contingencies or other technically feasible contingencies should be implemented to protect current or future downgradient production wells. Any contingent extraction

wells will be evaluated to ensure that the remedial benefit of extraction is balanced with the value of the resource (i.e., groundwater will be removed from storage only as necessary to achieve the ROs and the value of leaving groundwater in storage within the aquifer for potential future use will be considered).

Depending on the results of the hydrogeologic evaluation that would be reviewed by ADEQ, the COP and SRP, and other involved WVBWG members, the Preferred Remedy could result in implementation of one or more of the following additional contingent remedial measures:

- Installation, operation and treatment of a new 500 gpm extraction well, or if one had been previously installed, continued operation or expanded operation, with reinjection of the treated water;
- Installation, operation and treatment of a new 1,000 gpm extraction well, with reinjection of the treated water;
- In the event that SRP wells become impaired for their intended use as a result of WVBA contamination, then a contingent measure such as well replacement, or special well design and construction features may be appropriate. Up to two SRP wells could be replaced with collocated production wells of equivalent capacity completed solely in the LAU;
- Replacing well RID-114 at another location along the Salt Canal, outside of the plume boundary, combined with a well operational approach as currently employed by RID; and/or
- Other technically feasible measures.

Agricultural Groundwater Use: The ROs for current and reasonably foreseeable future agricultural groundwater use in and near the WVBA are:

- "To protect, restore, replace or otherwise provide for the current and reasonably foreseeable future supply of groundwater for agricultural/irrigation use and for the associated recharge capacity that is threatened by or lost due to contamination associated with the WVBA WQARF site. Remedial actions will be in place for as long as need for the water exists, the resource remains available and

the contamination associated with the WVBA WQARF site prohibits or limits groundwater use. Remedial actions to meet ROs will be implemented upon issuance of the ROD. If there is an imminent risk to human health or the environment, then an ERA may be initiated prior to implementation of the ROD."

RID operates 32 groundwater production wells within or adjacent to the WVBA. The results of the Human Health Risk Assessment (Haley & Aldrich, 2014) indicate that water from RID production wells is currently safe for its current agricultural/irrigation use without remedial measures. Concentrations of COCs in WVBA groundwater have generally declined or are stable. With ADEQ-directed source control measures, continued operation of the M52 remedy, and continued RID irrigation pumping until 2026, COC concentrations are expected to continue to decrease over time. The potential that COC concentrations will increase in RID wells used for irrigation is low. However, if concentrations of COCs in WVBA groundwater increase to levels that threaten or impair agricultural/irrigation use by RID or others, contingencies as identified in the Municipal Groundwater Use subsection could be implemented based on the actual conditions at that time.

Private Groundwater Use: The ROs for current and reasonably foreseeable future private groundwater use in and near the WVBA are:

- "To protect, restore, replace or otherwise provide a water supply for potable or non-potable use by currently impacted commercial, industrial, and domestic well owners within the WVBA WQARF site if the current and reasonably foreseeable future uses are impaired or lost due to contamination from the site. Remedial actions will be in place for as long as need for the water exists, the resource remains available and the contamination associated with the WVBA WQARF site prohibits or limits groundwater use. Remedial actions to meet ROs will be implemented upon issuance of the ROD. If there is an imminent risk to human health or the environment, then an ERA may be initiated prior to implementation of the ROD."

- "To protect, restore, replace or otherwise provide a water supply for potable or non-potable use by commercial, industrial, and domestic well owners outside the current plume boundaries of the WVBA WQARF site if the current and reasonably foreseeable future uses are impaired or lost due to

contamination from the site. Remedial actions will be in place for as long as need for the water exists, the resource remains available and the contamination associated with the WVBA WQARF site prohibits or limits groundwater use. Remedial actions to meet ROs will be implemented upon issuance of the ROD. If there is an imminent risk to human health or the environment, then an ERA may be initiated prior to implementation of the ROD."

The Land and Water Use study (Terranext, 2012b) identified a number of private wells within the WVBA plume area. Most of these private wells are used for irrigation or livestock. The private wells sampled have water quality suitable for their current uses according to ADEQ (Haley &Aldrich, 2014). There are no currently impaired private wells outside the WVBA. The water supply to any impaired private wells that become unfit for their end use as a result of WVBA contamination would be replaced. Such well properties will be connected to the COP municipal water distribution system at the appropriate time.

4.4.3 Remedial Objectives for Canal Water Use

The ROs for RID's current and reasonably foreseeable future canal water use in and near the WVBA are:

- "To protect, restore, replace or otherwise provide a water supply for potable or non-potable use by currently impacted RID wells within the WVBA WQARF site if the current and reasonably foreseeable future uses are impaired or lost due to contamination from the site. Remedial actions will be in place for as long as need for the water exists, the resource remains available and the contamination associated with the WVBA WQARF site prohibits or limits groundwater use. Remedial actions to meet ROs will be implemented upon issuance of the ROD. If there is an imminent risk to human health or the environment, then an ERA may be initiated prior to implementation of the ROD."

- "To protect, restore, replace or otherwise provide a water supply for potable or non-potable use by RID wells outside the current plume boundaries of the WVBA WQARF site if the current and reasonably foreseeable future uses are impaired or lost due to contamination from the site. Remedial actions will be in place for as long as need for the water exists, the resource remains available and the contamination associated with the WVBA WQARF site prohibits or limits groundwater use. Remedial actions to meet ROs will be implemented upon issuance of the ROD. If

there is an imminent risk to human health or the environment, then an ERA may be initiated prior to implementation of the ROD."

If RID is authorized in the reasonably foreseeable future to deliver water to third-party drinking water providers for potable use, measures may be needed to provide for that use. To the extent reclaimed wastewater from the COP's 23rd Avenue Wastewater Treatment Plant (WWTP) is conveyed via the Main Canal, the Main Canal cannot be used for delivering drinking water. Any use of the Main Canal for deliveries of water to drinking water providers could only begin after effluent discharges cease.

Assuming there is no effluent being conveyed in the Main Canal, to determine whether measures may be needed, a mass balance approach could be used to estimate TCE and PCE concentrations at the end of the Salt Canal, the end of the Main Canal, and the confluence of the two canals. A blending approach could be employed, consisting of blending extracted groundwater from RID wells at current rates within and adjacent to the WVBA. Mass balance calculations indicate that, under current RID pumping conditions, and using the most recent available water quality data from RID wells, blended water at the confluence of the Salt Canal and Main Canal would be below the AWQS for PCE and slightly above the AWQS for TCE (Haley & Aldrich, 2014). Blending additional water from other RID wells located within the SRRD and RID wells west of the Aqua Fria River would serve to reduce concentrations to below regulatory thresholds in the blended water prior to delivery to the west valley. Continued COC concentration declines over time within the WVBA would also result in lower concentrations in the future.

Water in the Salt Canal may meet AWQSs and be suitable for delivery to third-party drinking water providers should RID obtain authorization to make such deliveries and after RID completes construction of the infrastructure and obtains the contracts required to make such deliveries. If it does not, well RID-114 could be replaced as a contingent well measure should RID obtain authorization to employ only wells on the Salt Canal for drinking water supply end use. The highest VOC concentrations in RID wells along the Salt Canal are observed in well RID-114 based on historical data. If this well were addressed with a remedial measure such as well replacement, and the VOC concentrations were assumed to be non-detect in the replacement well, the blended TCE and PCE concentrations at the end of the Salt

Canal, based on 2014 concentrations, would calculate to 3.9 micrograms per Liter (µg/L) and 4.9 µg/L, respectively. Both of these concentrations are less than their respective AWQS.

4.4.4 Remedial Objectives for Surface Water Use

The ROs for SRP's current and reasonably foreseeable future surface water use in and near the WVBA are:

- "To protect, restore, replace or otherwise provide a water supply for potable or non-potable use by SRP wells outside the current plume boundaries of the WVBA WQARF site if the current and foreseeable future uses are impaired or lost due to contamination from the site. Remedial actions will be in place for as long as need for the water exists, the resource remains available and the contamination associated with the WVBA WQARF site prohibits or limits groundwater use. Remedial actions to meet ROs will be implemented upon issuance of the ROD. If there is an imminent risk to human health or the environment, then an ERA may be initiated prior to implementation of the ROD."

No SRP wells are currently located within the WVBA, but SRP has several groundwater production wells located in the vicinity of the WVBA that feed the SRP lateral system. Because SRP wells are used to supplement surface water supply on an as-needed basis, their annual groundwater use fluctuates depending upon the availability of surface water (SRP, 1996). To date, SRP's use of these wells has not been impacted by the WVBA groundwater plume. As a result of changing land use in the area, SRP anticipates that some SRP wells will eventually transition to a drinking water use in the reasonably foreseeable future, either by directly connecting the wells to municipal distribution systems within the SRRD, or piping to municipal water treatment plants located on the SRP canal system as a drought supply (SRP, 2011).

Several SRP wells are located northwest of the WVBA. Should regional pumping within and adjacent to the WVBA be significantly reduced or cease altogether, a rise in the water table and associated shift in groundwater flow direction from westerly to a more northwesterly direction is anticipated based on historical groundwater flow directions and the WVBWG's FS modeling results (Haley & Aldrich, 2014).

As described in the Municipal Groundwater Use subsection, extensive groundwater monitoring within the WVBA will provide the basis for determining which, if any, proposed contingent measures will be implemented. If the existing monitoring program was determined to be inadequate in the event that RID stops irrigation pumping in 2026 and groundwater flow direction in the WVBA system changes, additional new and existing UAU1 monitoring wells (twelve total) located along the northern and western perimeter of the WVBA, would be monitored for COCs starting in 2026. In addition, if operating, the eleven SRP wells located west and northwest of the WVBA, would also be sampled and analyzed for COCs during the sentinel monitoring events

The hydrogeologic evaluation conducted at the end of 2025 would be used to determine, based upon the 2025 water level elevation and water quality conditions within the WVBA plume, if proposed contingencies or other technically feasible contingencies should be implemented to protect current or future downgradient production wells.

In the event that the SRP wells become impaired for their intended use as a result of WVBA contamination, then a contingent measure such as well replacement, or special well design and construction features may be appropriate. Up to two SRP wells could be replaced with collocated production wells of equivalent capacity completed solely in the LAU.

4.5 Consistency with Water Management Plans

City of Phoenix: Currently there are no COP production wells within the WVBA. The 2011 update to the COP's Water Resources Plan provided information on water acquisition, water management, and infrastructure needed to ensure a sustainable water supply for current customers and anticipated growth over the next 50 years. In a normal supply year, the COP water demand of approximately 302,000 AFY is currently met with the following sources:

- SRP (50 percent);
- Central Arizona Project ([CAP]; 44 percent);
- Reclaimed Water (3 percent); and

- Groundwater (3 percent).

In years with surface water shortfalls, a portion of the COP supply may consist of groundwater pumped from SRP wells. The COP also maintains a number of groundwater production wells for operational flexibility and use when CAP and/or SRP supplies are reduced (COP, 2011). As noted above, currently there are no COP or SRP production wells within the WVBA.

Historically, the COP developed or acquired more than 200 production wells, although the COP has removed a majority of these wells from service due to age, decreased efficiency, and/or degraded groundwater quality.[2] From 1981 to 2000, the total loss of COP well production due to degraded groundwater quality exceeded 90,000 AFY. While some COP production wells have been impacted by VOCs, many COP wells have been closed due to groundwater degradation from inorganic constituents such as chromium, arsenic, and nitrate (COP, 2011).

The COP currently has access to 25 groundwater production wells that can generate 28 million gallons of water per day, or approximately 31,350 AFY. These wells are located 1 mile or more from the WVBA, mostly in the north-central portion of the COP, and are used for operational flexibility and during times of reduced CAP and/or SRP surface water supplies. The actual number of available production wells varies at any given time due to maintenance issues. Based on the current COP production well capacity and a 65 percent duty cycle, the COP can produce approximately 20,000 AFY from these wells (COP, 2011).

The current projected groundwater use for normal supply years and General Plan-based growth is 15,000 AFY, although withdrawals in recent years have been lower, averaging approximately 9,000 AFY. The COP is evaluating the expansion of its groundwater production well network to increase operational flexibility, manage water quality, and reduce the impacts of potential future surface water shortages.

[2] COP Well #179, the only COP production well located within the WVBA, has been abandoned.

Salt River Project: There are no SRP wells currently located within the WVBA. The SRP manages surface water and groundwater rights within the SRRD geographic region. The WVBA is within SRP "Member" lands and groundwater within the WVBA underlies the SRRD.

SRP has several groundwater production wells located in the vicinity of the WVBA that feed the SRP lateral system. Because SRP wells are used to supplement surface water supply on an as-needed basis, their annual groundwater use fluctuates depending upon the availability of surface water (SRP, 1996). From 2003 through 2013, total SRP pumping within 5 miles of the WVBA ranged from 13,500 AFY in 2008 to 72,300 AFY in 2003. The total depth of these wells range from about 500 to 1,500 feet deep, in most cases constructed with 16- to 20-inch casing, and are generally completed within the UAU and MAU, although some are completed in the MAU and LAU.

During 2012, approximately 64 percent of water delivered by SRP was for municipal/industrial use within the totality of the SRP service area, with 36 percent for agricultural use, turf irrigation, and recreational use. These percentages have been relatively consistent since 2007 (SRP, 2013).

To date, no SRP wells have been impaired by the WVBA plume (SRP, 2011).

Roosevelt Irrigation District: RID pumps the largest amount of groundwater within the WVBA under contracts with the SRP, and all of it is used to provide irrigation water to members in RID's service area west of the Agua Fria River, outside of the WVBA.

In the late 1910s, waterlogged land resulting from regional hydrogeologic conditions and irrigation return flows threatened local farming operations within the WVBA. In 1920, SRP entered into an agreement with the Carrick and Mangham Agua Fria Lands and Irrigation Company (RID's predecessors) to withdraw a certain amount of groundwater to help alleviate the waterlogged conditions. According to SRP, the 1920 agreement and subsequent supplemental agreements for water production with Carrick-Mangham and RID will expire no later than 2026 (SRP, 2009).

RID operates approximately 50 wells within the SRRD during the peak irrigation season, generally from March to September (Terranext, 2012b) and 32 of these wells are located within or adjacent to the WVBA. Total annual RID pumping within the SRRD is approximately 135,000 AFY (SRP, 2009), which is

conveyed to the RID irrigation service area west of the Agua Fria River via a system of canals and pipelines. About 75,000 AFY is pumped from 32 RID wells within and adjacent to the WVBA and 60,000 AFY are pumped from the remaining 18 RID wells.

During 2008 and 2009, the average pumping rate of RID wells within the WVBA ranged from approximately 1,500 to 4,800 gpm (Montgomery & Associates, 2009a). Total depths of RID wells located within and adjacent to the WVBA range from 284 to 1,800 feet deep. Most of the RID wells are screened across the UAU1, UAU2, and into the upper MAU, with some of the deeper wells screened across the UAU1, UAU2, MAU, and into the LAU.

The COP 23rd Avenue WWTP discharges approximately 30,000 AFY to the RID Main Canal on a year-round basis as part of a "3-way exchange" between the COP, RID, and SRP in which: (1) the COP delivers up to 30,000 AFY of reclaimed water to RID for irrigation use within RID's service area; (2) RID leases SRP wells to provide a like amount of water to the SRP canal system; and (3) SRP then delivers up to 20,000 AFY of surface water to the COP water treatment plants and up to 10,000 AFY of surface water to the Salt River Pima-Maricopa Indian Community (COP, 2006).

City of Tolleson: The COP supplies the COT with municipal water through an Inter-Governmental Agreement. The COT also has four production wells located west of the WVBA that are mainly used in the summer months as a backup supply (COT, 2005). During 2009, the total production from COT wells was approximately 750 AFY.

4.6 Consistency with Land Use Planning

The WVBA is located within the COP and abuts the COT's eastern boundary at 75th Avenue. Current and future land use is provided in the COP's General Plan, which includes the goals, policies, and recommendations for land use development during the next 10 to 20+ years.

The COP is made up of 15 "urban villages"; the Central City and Estrella urban villages are located within the WVBA. While overall land use, employment, and population within Central City are not expected to change significantly over time, the COP has identified Estrella as a targeted growth area because of the amount of agricultural land available for residential and/or commercial development. Estrella is

therefore expected to have significant increases in both employment and residential growth. The projected residential growth within Estrella is primarily outside of the WVBA, south of Lower Buckeye Road and west of 75th Avenue. Based on the COP General Plan, land use within the WVBA is projected to continue to be predominantly industrial.

The following table provides the actual 2002 and projected General Plan land uses in Central City and Estrella.

Table 2. Projected General Plan Land Uses – Central City and Estrella

	Central City		Estrella	
Land Use Category	**2002 Land Use (% of total)**	**General Plan (% of total)**	**2002 Land Use (% of total)**	**General Plan (% of total)**
Large Lot Residential	11%	16%	4%	10%
Small Lot Residential			4%	27%
Medium Density Residential	3%	5%	1%	4%
High Density Residential	2%	1%	1%	0.2%
Commercial	9%	14%	1%	3%
Industrial	16%	23%	18%	35%
Commerce Park	6%	0.10%	0.3%	4%
Public/Quasi Public	8%	7%	8%	8%
Transportation/Airport	28%	21%	1%	1%
Parks -Open Space	6%	13%	6%	8%
Agriculture	0.01%	---	49%	---
Vacant	9%	---	7%	---

Source: COP General Plan

By 2030, Central City and Estrella are projected to grow to the following numbers (the increase shown is from actual 2000 to projected 2030 numbers):

- Central City: Employment (116,000; 1.07X increase); population (164,000; 1.2X increase); and households (66,000; 1.11X increase).
- Estrella: Employment (148,000; 3.13X increase); population (146,000; 3.36X increase); and households (40,000; 4.2X increase).

In 2000, the highest percentages of land use for the COT were agriculture (46 percent); industrial/warehouse (24 percent); and residential (14 percent). Land use in the eastern portion of the COT, adjacent to the WVBA, is primarily agriculture and industrial (Terranext, 2012b).

4.7 Achievement of Remedial Action Criteria Pursuant to A.R.S. §49-282.06

The Preferred Remedy satisfies the Remedial Action Criteria of A.R.S. §49-282.06. The Preferred Remedy assures the protection of public health, welfare, and the environment. Using remedial strategies, remedial measures, and contingencies reduces the concentration, volume, mass, and toxicity of COCs over time. Risk from potable use of an impaired well in the reasonably foreseeable future is mitigated or eliminated using a combination of remedial measures and contingencies.

To the extent practicable, the Preferred Remedy provides for the control, management, or cleanup of hazardous substances to allow for the maximum beneficial use of the waters of the state. Potable water use in the reasonably foreseeable future would be managed using remedial measures and contingencies. The Preferred Remedy remedial strategies, measures, and contingencies allows for beneficial use of groundwater within the WVBA.

The Preferred Remedy is reasonable, necessary, cost-effective, and technically feasible. The Preferred Remedy is a balanced, cost-effective approach to meeting the ROs and is reasonable and technically feasible because the remedy components can be implemented using industry-standard methods. The remedial measures and contingent measures also address wells that may become impaired in the future.

Using remedial strategies, remedial measures, and contingencies, the Preferred Remedy addresses, at a minimum, any well that at the time of selection of the remedial action either supplies water for municipal, domestic, industrial, irrigation, or agricultural uses or is part of a public water supply system if the well would now or in the reasonably foreseeable future produce water that would not be fit for its current or reasonably foreseeable end uses without treatment due to the release of hazardous substances. The specific measures to address any such well would not reduce the supply of water available to the owner of the well.

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APPENDIX A

MATRIX-CALIBRE EVALUATION OF FEASIBILITY STUDIES REGARDING TECHNICAL COMPLETENESS, WEST VAN BUREN WATER QUALITY ASSURANCE REVOLVING FUND SITE DATED JULY 28, 2015

Memorandum

To: Laura Malone, ADEQ

From: Tom McKeon & Julie Carver, Matrix-CALIBRE

Date: July 28, 2015

Subject: Evaluation of Feasibility Studies Regarding Technical Completeness, West Van Buren Water Quality Assurance Revolving Fund (WQARF) Site

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The Matrix-CALIBRE Team is under contract with the Arizona Department of Environmental Quality (ADEQ) to complete a Task Order (TO) for the West Van Buren (WVB) Water Quality Assurance Revolving Fund (WQARF) Site located in Phoenix, Arizona (hereafter referred to as the Site). An objective of the TO was to evaluate two Feasibility Studies that were prepared for the Site and submitted to ADEQ by external parties under Arizona Administrative Code (A.A.C.) R18-16-413 and A.A.C. R18-16-407. One element of the Feasibility Study evaluation was to conduct a review of the Feasibility Study technical completeness pursuant to the requirements set forth in the Arizona Revised Statues (A.R.S.) § 49-282.06 and the A.A.C. R18-16-407. This Technical Memorandum summarizes the technical completeness review of the two Feasibility Studies.

Background

Two separate Feasibility Studies for the Site were submitted to ADEQ in 2014; one prepared by Synergy Environmental, LLC and Montgomery and Associates on behalf of the Roosevelt Irrigation District (RID) and the other prepared by Haley and Aldrich, Inc. on behalf the West Van Buren Working Group (WVBWG).

Feasibility Study Evaluation

The two Feasibility Studies were evaluated and the results are summarized in the attached tables. Table 1 presents a very brief summary of the remedial alternatives considered in the two Feasibility Studies. The Table 1 summary is intentionally brief, for further details consult the original Feasibility Studies. The technical completeness evaluation of the two Feasibility Studies is summarized in Tables 2 and 3 for the selected remedies from each Feasibility Study. The technical completeness evaluation summarizes the relevant requirements from A.R.S. § 49-282.06 and A.A.C. R18-16-407 and describes how each of the recommended remedies considers and addresses those requirements.

Based on the technical completeness evaluation, the two Feasibility Studies were deemed by the Matrix-CALIBRE Team as technically complete. The resumes of the Matrix-CALIBRE Team staff that completed the technical evaluation are attached.

Table 1 WVB Site Feasibility Studies; Summary Table

	RID Reference Remedy	***RID Less Aggressive***	RID More Aggressive	RID Most Aggressive	***WVBWG Reference Remedy***	WVBWG Less Aggressive	WVBWG More Aggressive
Remedial Strategy	PR & PC	PR & PC	PR & PC	PR & PC	CM	CM	CM & PC
Approach	P&T 9 current supply wells	P&T 6 current supply wells	P&T 6 current supply wells	P&T 13 current supply wells	RID operates + P&T 1 new well	RID operates	RID operates + P&T 2 new wells
Measures/ Elements to meet goals	RID Extraction & Treatment	RID Extraction & Treatment	RID Extraction & Treatment	RID Extraction & Treatment	RID Extraction, MNA, minor treatment & contingencies	RID Extraction, MNA & contingencies	RID Extraction, MNA, limited treatment & contingencies
Source Control	by ADEQ	by ADEQ	by ADEQ	by ADEQ	by ADEQ	by ADEQ	by ADEQ
Actions to meet potable use	Treatment at selected wells (9) & blending (6 more)	Treatment at selected wells (6) & blending (9 more)	Treatment at selected wells (6) & blending (9 more)	Treatment at all wells (13)	Blending & 1 well replacement; Replace any domestic use well	Blending & 1 well replacement; Replace any domestic use well	Blending & 1 well replacement; Replace any domestic use well
Well replacement/ improvement	Replace 2: RID-92 & RID-106; improve RID-84, RID-114	Replace 1: RID-106; improve RID-84, RID-114	Replace 1: RID-106; improve RID-84, RID-114	Replace 2: RID-92 & RID-106; improve RID-84, RID-114	If converted to potable use: move & replace RID-114	If converted to potable use: move & replace RID-114	If converted to potable use: move & replace RID-114
Other	various**	various**	various** + Recharge of WWTP effluent++	various**	Contingencies for COT, SRP, and COP supply wells	Contingencies for COT, SRP, and COP supply wells	Contingencies for COT, SRP, and COP supply wells
Groundwater Monitoring	yes	yes	yes	yes	Yes + contingency expansion of MWs	Yes +contingency expansion of MWs	Yes + contingency expansion of MWs
Cost over 30 years as sum of $s spent (not net present value)	$104M	$71M	$80.6M	$145M	$88.6M (w' sum of all contingencies)	$24.2M (w' sum of all contingencies)	$102.5M (w' sum of all contingencies)

Bold – Proposed Remedy based on FS Evaluation

** Various system improvements; Enclose lateral from RID-92 to Main canal, Salt canal improvements, seal all manholes

++ WWTP effluent recharge via RID-84, RID-85, RID-90, RID-91, and RID-93

CM – Controlled migration; PC – Plume containment; PR – Plume remediation; P&T – Groundwater extraction and treatment
ADEQ – Arizona Department of Environmental Quality
COP – City of Phoenix
COT – City of Tolleson
GAC – granular activated carbon
MNA – monitored natural attenuation
RID – Roosevelt Irrigation District
SRP – Salt River Project
WVBWG – West Van Buren Working Group
WWTP – Waste Water Treatment Plant

Matrix-CALIBRE Team

Table 2 Technical Evaluation: Roosevelt Irrigation District
Proposed Remedy – "Less Aggressive"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
R18-16-407(A)	The feasibility study (FS) is a process to identify a reference remedy and alternative remedies that appear to be capable of achieving remedial objectives (ROs) and to evaluate them based on the comparison criteria to select a remedy that complies with A.R.S. § 49-282.06.	Administratively complete (1).
A.R.S. § 49-282.06(A)(1-3)	Remedial actions **shall**:	
	1. Assure the protection of public health and welfare and the environment.	Current risks are within acceptable thresholds for present use, remedial actions taken would not lower current risks by an appreciable amount. Remedial actions taken would lower future risks when resource is used for potable supply.
	2. To the extent practicable, provide for the control, management or cleanup of the hazardous substances to allow the maximum beneficial use of the waters of the state.	Pump and treat will contain the plume and have mass removal but may not achieve aquifer restoration in a timely manner. Acknowledges that source control by ADEQ is necessary.
	3. Be reasonable,	Remedial actions are not required for current use therefore they are not reasonable at this time; however they are reasonable for future potable use of the resource.
	necessary,	Not necessary until such time as future use of the resource is for potable supply; includes elements targeted more for water supply development rather than remediation. Examples include converting the lateral canal to piping at RID-92 and sealing all manholes/vaults.
	cost-effective, and	At the time when potable use of the water is needed, this would be cost effective.
	technically feasible.	Feasible (liquid phase carbon treatment is a reliable treatment technology).

Table 2 Technical Evaluation: Roosevelt Irrigation District
Proposed Remedy – "Less Aggressive"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
A.R.S. § 49-282.06(B)(4)(b)	[…]. Rules adopted pursuant to this subsection shall include rules for: […] 4. The selection of remedial actions including the establishment of the level and extent of cleanup at a site or a portion of a site. The rules **shall** provide for the selection of a remedial action by comparison of alternative remedial actions, which may include: no action, monitoring, source control, controlled migration, physical containment, plume remediation, and the consideration of the criteria in subsection (C) of this section. The rules also **shall** provide that the selected remedial action meet the requirements of subsection A of this section and the following:	The basic remedial strategies are discussed in the FS. Acknowledges that source control by ADEQ is necessary.
	a. […soil only...]	Not Applicable.
	b. For remediation of waters of the state, the selected remedial action shall address, at a minimum, any well that at the time of selection of the remedial action either supplies water for municipal, domestic, industrial, irrigation or agricultural uses or is part of a public water system if the well would now or in the reasonably foreseeable future produce water that would not be fit for its current or reasonably foreseeable end uses without treatment due to the release of hazardous substances. The specific measures to address any such well shall not reduce the supply of water available to the owner of the well.	Current irrigation use is not impaired; foreseeable future includes potable use. Relies on a combination using treatment of selected wells with blending to meet potable use criteria in the Salt canal.
	5. Incentives for initiating early remedial actions and implementing innovative remedial technologies	An administrative action (2).
A.R.S. § 49-282.06(C)(1-3)	In adopting the rules required by this section and in selecting remedial actions, the director **shall** consider the following factors:	
	1. Population, environmental and welfare concerns at risk.	Presently, levels are not above risk thresholds (ADHS, 2015); if and when changes in groundwater use occur corresponding risks are addressed.
	2. Routes of exposure.	Presently, levels are not above risk thresholds (ADHS, 2015); if and when changes in groundwater use occur corresponding risks are addressed.
	3. Amount, concentration, hazardous properties, environmental fate, such as the ability to bioaccumulate, persistence and probability of reaching the waters of the state, and the form of the substance present.	Most of the plume is at concentrations near the Aquifer Water Quality Standards (AWQSs) for PCE and TCE (range: 5-15 micrograms per liter). Limited areas have higher concentrations (more than 4 times the AWQSs). Plume is already in 'waters of the state'.
28	4. Physical factors affecting human and environmental exposure such as hydrogeology, climate and the extent of previous and expected migration.	Presently, levels are not above risk thresholds (ADHS, 2015); if and when changes in groundwater use occur corresponding risks are addressed.

Table 2 Technical Evaluation: Roosevelt Irrigation District
Proposed Remedy – "Less Aggressive"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
	5. The extent to which the amount of water available for beneficial use will be preserved by a particular type of remedial action.	Future water rights are to be determined (outside of ADEQ). The remedial action removes the groundwater resource from the current water basin.
	6. The technical practicality and cost-effectiveness of alternative remedial actions applicable to a site.	It is feasible/practicable when potable supply is needed; the proposed remedy (less aggressive) is more cost-effective as compared to the reference remedy.
	7. The availability of other appropriate federal or state remedial action and enforcement mechanisms, including, to the extent consistent with this article, funding sources established under CERCLA, to respond to the release.	Not directly applicable (2).
A.R.S. § 49-282.06(D)	Notwithstanding this article, the director may approve a remedial action that may result in water quality exceeding water quality standards after the completion of the remedy if the director finds that the remedial action meets the requirements of this section.	An administrative action, to be completed as necessary (3).
R18-16-407(B) & (B)(3)	[…] The FS process **shall** include community involvement procedures in compliance with R18-16-404. […] […]Notification to interested persons of the availability of FS workplan in accordance with R18-16-404[(C)(1)(d)].[…]	Completed in conjunction with ADEQ. Completed in conjunction with ADEQ.
R18-16-407(C) & (D)	Not Applicable.	Not Applicable.

Table 2 Technical Evaluation: Roosevelt Irrigation District
Proposed Remedy – "Less Aggressive"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
R18-16-407(E)(1-2)	[…], the FS **shall** provide for the development of a reference remedy and at least 2 alternative remedies as follows:	Reference remedy and 3 alternates (less aggressive, more aggressive, most aggressive) are presented in the FS.
	1. The reference remedy and alternative remedies **shall** be capable of achieving all of the ROs. The reference remedy **and each** alternative remedy **shall** consist of a remedial strategy under subsection (F) and all remedial measures to be employed. The combination of the remedial strategy and the remedial measures for each alternative remedy **shall** achieve the ROs. […] The reference remedy and other alternative remedies **shall** be developed and described in the FS report in sufficient detail to allow evaluation using the comparison criteria, […].	The FS describes how the ROs are met, the 4 remedies considered are summarized and evaluated in comparison to the applicable criteria [A.R.S. § 49-282.06, and A.A.C. R18-16-407(H)].
	2. The reference remedy **shall** be developed based upon best engineering, geological, or hydrogeological standards of practice, considering the following: a. The information in the remedial investigation; b. The best available scientific information concerning available remedial technologies, and c. Preliminary analysis of the comparison criteria and the ability of the reference remedy to comply with A.R.S. § 49-282.06. […]	The remedies presented are developed based on the RI data and the best professional judgments of the authors (licensed engineers and/or geologists).
R18-16-407(E)(3)	3. At a minimum, at least 2 alternative remedies **shall** be developed for comparison with the reference remedy. At least one of the alternative remedies must employ a remedial strategy or combination of strategies that is more aggressive than the reference remedy, and at least one of the alternative strategies that is less aggressive than the reference remedy	The remedies presented include a reference remedy and three alternates; two more aggressive, one less aggressive (in comparison to the reference remedy).
R18-16-407(F)(1-6)	The remedial strategies to be developed under subsection (E) are listed below. Source control **shall** be considered as an element of the reference remedy and all alternative remedies, if applicable, except for the monitoring and no action alternatives. […] The remedial strategies are: 1. Plume remediation […] achieve water quality standards for COCs in waters of the state throughout the site. 2. Physical containment […] contain contaminants within definite boundaries. 3. Controlled migration […] control the direction or rate of migration but not	The basic remedial strategies are discussed in the FS. Acknowledges that source control by ADEQ is necessary. Physical containment through extraction by RID and monitoring is the current condition; increased plume remediation via preferential pumping of higher concentration wells is added.

Table 2 Technical Evaluation: Roosevelt Irrigation District
Proposed Remedy – "Less Aggressive"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
	necessarily to contain migration of contaminants. 4. Source control […] eliminate or mitigate a continuing source of contamination. 5. Monitoring […] observe and evaluate the contamination at the site through the collection of data. 6. No action […] consists of no action at a site.	
R18-16-407(G)	Remedial measures necessary for each alternative remedy developed under subsection (E) to achieve ROs or to satisfy the requirements of A.R.S. § 49-282.06(B)(4)(b) **shall** be identified in consultation with water providers or known well owners whose water supplies are affected by the release or threatened release of a hazardous substance. In identifying the remedial measures, the needs of the well owners and the water providers and their customers, including the quantity and quality of water, water rights and other legal constraints on water supplies, reliability of water supplies and any operational implications **shall** be considered. Such remedial measures may include, but are not limited to: well replacement, well modification, water treatment, provision of replacement water supplies, and engineering controls. Where remedial measures are relied upon to achieve ROs, such remedial measures **shall** remain in effect as long as required to ensure the continued achievement of those objectives.[…]	The FS describes consultation and consideration of RID water supply and use; SRP supply and use; City of Phoenix (COP) supply and use. Consideration of domestic supply wells (if impaired) in the impacted area is not discussed. The FS provides a discussion of options for replacement water supplies noting that the large volume of replacement water that may be required would be challenging to procure. In addition, the FS notes that the existing pumping by RID contains the plume and a replacement supply would therefore allow the plume to migrate. Based on these considerations, the FS rejects replacement supply from further consideration.
R18-16-407(H)(1-3a)	The Department **shall** conduct a comparative evaluation of the reference remedy and the alternative remedies developed under subsection (E). For each alternative, the evaluation **shall** be reported in a FS report and **shall** include:	
	1. A demonstration that the remedial alternative will achieve the ROs.	Demonstration is presented to meet "*protect, restore, replace or otherwise provide a water supply for municipal use by currently and reasonably foreseeable future municipal well owners within the WVB Area".* The remedial actions are planned as well-head treatment to protect the water supply from existing irrigation wells that are planned to serve as municipal supply in the reasonably foreseeable future.
	2. An evaluation of consistency with the water management plans of affected water providers and the general land use plans of local governments with land use jurisdiction.	The FS presents remedial actions that are consistent with RID's development plans. Other water providers and local governments have raised issues regarding RID's plans in their public comments.
	3. An evaluation of the comparison criteria, including:	
	a. An evaluation of the practicability of the alternative,	It is practicable; however current risks are within acceptable thresholds for present use.

Table 2 Technical Evaluation: Roosevelt Irrigation District
Proposed Remedy – "Less Aggressive"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
	including its feasibility,	Yes, it is feasible.
	short and long-term effectiveness, and reliability,	Remedial actions are effective for plume containment and potable supply.
	considering site-specific conditions, characteristics of the contamination resulting from the release, performance capabilities of available technologies, and institutional considerations.	Institutional considerations for resolution include water rights and exporting from the current water basin. These are outside of ADEQ's purview. GAC treatment can meet the ROs and project goals.
R18-16-407(H)(3b-3d)	b. An evaluation of risk, including the overall protectiveness of public health and aquatic and terrestrial biota under reasonably foreseeable use scenarios and end uses of water. This evaluation **shall** address: i. Fate and transport of contaminants and concentrations and toxicity over the life of the remediation; ii. Current and future land and resource use; and iii. Exposure pathways, duration of exposure, and changes in risk over the life of the remediation; iv. Protection of public health and aquatic and terrestrial biota while implementing the remedial action and after the remedial action; and v. Residual risk in the aquifer at the end of remediation	Remedy is protective for future resource use. Remedy is focused on plume containment and water supply treatment. Source control remedial actions are to be implemented by ADEQ. The evaluation of risk notes that the current concentrations measured (in vapor and in water) do not represent an acute risk (Synergy, 2011). The FS compares concentrations with applicable screening criteria (i.e., specific numerical criteria established for protection of human health) with a prospective comparison of historical conditions (without historical exposure estimates) rather than current resource use and exposure pathways. This presentation of risk evaluation [under R18-16-407(H)(3b)] focuses more on the prospective impacts as opposed to current conditions over the life of the remediation. The consideration of current and future uses may place more emphasis on the timing as to when the proposed remedial actions are necessary. Residual risks will remain in the aquifer.
	c. An evaluation of the cost of the remedial alternative, including the expenses and losses including capital, operating, maintenance, and life cycle costs. Transactional costs necessary to implement the remedial alternative, including the transactional costs of establishing long-term financial mechanisms, such as trust funds, for funding of an alternative remedy, shall be included in the cost estimate.	The FS presents costs for the reference remedy and each alternate. The costs for the proposed remedy (less aggressive) are: $9.5M capital plus $2.05M operations and maintenance (O&M) for 100 years. **At 30 years: $71.M spent**. The costs presented above represent the sum of costs and are not converted to a net present value basis.

Table 2 Technical Evaluation: Roosevelt Irrigation District
Proposed Remedy – "Less Aggressive"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
	d. An evaluation of the benefit, or value, of the remediation. This analysis includes factors such as: i. Lowered risk to human and aquatic and terrestrial biota; ii. Reduced concentration and reduced volume of contaminated water; iii. Decreased liability; acceptance by the public; iv. Aesthetics; preservation of existing uses; v. Enhancement of future uses; and vi. Improvements to local economies.	Potable water will be available; the remedial action will slowly reduce plume concentration and volume.
R18-16-407(H)(3e)	e. A discussion of the comparison criteria, as evaluated in relation to each other.	Discussion regarding each remedy in relation to each other is present.
R18-16-407(I)	Based upon the evaluation and comparison of the reference remedy and the other alternative remedies developed under subsection (E), a proposed remedy **shall** be developed and described in the FS report. The proposed remedy may be the reference remedy, any of the other alternative remedies evaluated in the FS, or a different combination of remedial strategies and remedial measures that were included in the alternative remedies evaluated in the FS. The FS report **shall** describe the reasons for selection of the proposed remedy, including **all** of the following: 1. How the proposed remedy will achieve the ROs; 2. How the comparison criteria were considered; and 3. How the proposed remedy meets the requirements of A.R.S. § 49-282.06.	The proposed remedy is the Less Aggressive Alternative Remedy. The FS describes how the ROs are met. The FS describes the consideration of comparison criteria. The FS describes how the recommended remedy meets the A.R.S. requirements.
R18-16-407(J)	Any person, other than a person proposing to perform work under an agreement under A.R.S. § 49-287.03(C), may submit a request in compliance with R18-16-413 for the Department to approve a work plan or a report for all or any portion of a feasibility study. The Department **shall** approve a feasibility study report if the feasibility study complies with this Section and community involvement activities have been conducted under this Article.	Administratively complete for work plan requirement (3). Technical evaluation/analysis presented in the FS and the community involvement activities that have been completed comply with the referenced section and article.

(1) Administrative requirement; the FS submitted (and this specific remedial alternative) meets this threshold

Table 2 Technical Evaluation: Roosevelt Irrigation District
Proposed Remedy – "Less Aggressive"

(2) Not applicable to site status, WQARF process and ADEQ remedy selection.

(3) Process step that is applicable under WQARF and it has been completed (or in process of completion)

References:

ADHS, 2015. Health Consultation: Evaluation of Water Sampling Results in the Roosevelt Irrigation District (RID) Phoenix, Maricopa County, Arizona. Arizona Department of Health Services. January 8, 2015.

Synergy, 2011. Public Health Exposure Assessment and Mitigation Summary Report. Synergy Environmental, LLC. September 16, 2011.

Table 3 Technical Evaluation: West Van Buren Working Group (WVBWG)
Proposed Remedy – "Reference Remedy"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
R18-16-407(A)	The feasibility study (FS) is a process to identify a reference remedy and alternative remedies that appear to be capable of achieving remedial objectives (ROs) and to evaluate them based on the comparison criteria to select a remedy that complies with A.R.S. § 49-282.06.	Administratively complete (1).
A.R.S. § 49-282.06(A)(1-3)	Remedial actions **shall**:	
	1. Assure the protection of public health and welfare and the environment.	Current risks are within acceptable thresholds for present use, remedial actions taken would not lower current risks by an appreciable amount. Contingency remedial actions are planned that would lower risk if resource is used for potable supply in future.
	2. To the extent practicable, provide for the control, management or cleanup of the hazardous substances to allow the maximum beneficial use of the waters of the state.	Pump and treat will contain the plume and have mass removal but may not achieve aquifer restoration in a timely manner; plume migration is currently controlled by pumping for irrigation use. Acknowledges that source control by ADEQ is necessary.
	3. Be reasonable,	Most remedial actions are delayed until the resource is used for future potable use; adding one (1) well at 500 gallons per minute (gpm) does not appreciably improve current mass removal – this element is not reasonable.
	necessary,	Most remedial actions are postponed until they are necessary such as future use of resource as potable water supply.
	cost-effective, and	Cost effective when potable use of water supply is needed, relies heavily on blending to meet potable use criteria.
	technically feasible.	Feasible, although if/when Roosevelt Irrigation District (RID) ceases pumping, the following elements may not be a robust solution: Moving RID-114 to a down-gradient position. Projection of plume conditions in 2026 is optimistic based on the estimated rate of attenuation/concentration reductions. Allowing the plume to migrate to City of Tolleson (COT) and/or Salt River Project (SRP) wells.

Table 3 Technical Evaluation: West Van Buren Working Group (WVBWG)
Proposed Remedy – "Reference Remedy"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
A.R.S. § 49-282.06(B)(4)(b)	[…]. Rules adopted pursuant to this subsection shall include rules for: […]	
	4. The selection of remedial actions including the establishment of the level and extent of cleanup at a site or a portion of a site. The rules **shall** provide for the selection of a remedial action by comparison of alternative remedial actions, which may include: no action, monitoring, source control, controlled migration, physical containment, plume remediation, and the consideration of the criteria in subsection (C) of this section. The rules also **shall** provide that the selected remedial action meet the requirements of subsection A of this section and the following:	The basic remedial strategies are discussed in the FS. Acknowledges that source control by ADEQ is necessary. The recommended remedy is protective of public health and the environment; it provides for practicable control, management or cleanup of the hazardous substances to allow the maximum beneficial use of the waters of the state; and is reasonable, necessary, cost-effective, and technically feasible.
	a. […soil only...]	Not Applicable.
	b. For remediation of waters of the state, the selected remedial action shall address, at a minimum, any well that at the time of selection of the remedial action either supplies water for municipal, domestic, industrial, irrigation or agricultural uses or is part of a public water system if the well would now or in the reasonably foreseeable future produce water that would not be fit for its current or reasonably foreseeable end uses without treatment due to the release of hazardous substances. The specific measures to address any such well shall not reduce the supply of water available to the owner of the well.	Current irrigation use is not impaired; foreseeable future includes potable use. This remedy includes remedial actions to meet the potable criteria on the Salt and RID canals (not on a well-by-well basis) and relies on blending with replacement of one well (RID-114).
	5. Incentives for initiating early remedial actions and implementing innovative remedial technologies	An administrative action (2).
A.R.S. § 49-282.06(C)(1-3)	In adopting the rules required by this section and in selecting remedial actions, the director **shall** consider the following factors:	
	1. Population, environmental and welfare concerns at risk.	Presently, levels are not above risk thresholds (ADHS, 2015); future changes in groundwater use and corresponding risk are addressed.
	2. Routes of exposure.	Presently, levels are not above risk thresholds (ADHS, 2015); future changes in groundwater use and corresponding risk are addressed.
	3. Amount, concentration, hazardous properties, environmental fate, such as the ability to bioaccumulate, persistence and probability of reaching the waters of the state, and the form of the substance present.	Most of the plume is at concentrations near the Aquifer Water Quality Standards (AWQSs) for PCE and TCE (range: 5-15 micrograms per liter). Limited areas have higher concentrations (more than 4 times the AWQSs). Plume is already in 'waters of the state'.

Table 3 Technical Evaluation: West Van Buren Working Group (WVBWG) Proposed Remedy – "Reference Remedy"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
A.R.S. § 49-282.06(C)(4-7)	4. Physical factors affecting human and environmental exposure such as hydrogeology, climate and the extent of previous and expected migration.	Presently, levels are not above risk thresholds (ADHS, 2015); future changes in groundwater use and corresponding risk are addressed.
	5. The extent to which the amount of water available for beneficial use will be preserved by a particular type of remedial action.	Future water rights are to be determined (outside of ADEQ). If RID ceases pumping, the groundwater resource could stay within the boundaries of the current water basin.
	6. The technical practicality and cost-effectiveness of alternative remedial actions applicable to a site.	It is feasible/practicable but some elements of the proposed remedial measures may require significant modifications. An overall cost-effective approach is proposed but some elements of the proposed remedial measures are not; 1) adding one 500 gpm extraction well to the existing RID extraction rates; 2) moving RID-114 downgradient (shutting down RID-114 would likely impact RID -113 instead) and a well-head treatment system already exists on RID-114.
	7. The availability of other appropriate federal or state remedial action and enforcement mechanisms, including, to the extent consistent with this article, funding sources established under CERCLA, to respond to the release.	Not directly applicable (2).
A.R.S. § 49-282.06(D)	Notwithstanding this article, the director may approve a remedial action that may result in water quality exceeding water quality standards after the completion of the remedy if the director finds that the re0edial action meets the requirements of this section.	An administrative action, to be completed as necessary (3).
R18-16-407(B) & (B)(3)	[…] The FS process **shall** include community involvement procedures in compliance with R18-16-404. […]	Completed in conjunction with ADEQ.
	[…]Notification to interested persons of the availability of FS workplan in accordance with R18-16-404[(C)(1)(d)].[…]	Completed in conjunction with ADEQ.

Table 3 Technical Evaluation: West Van Buren Working Group (WVBWG) Proposed Remedy – "Reference Remedy"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
R18-16-407(C) & (D)	Not Applicable.	Not Applicable.
R18-16-407(E)(1-2)	[…], the FS **shall** provide for the development of a reference remedy and at least 2 alternative remedies as follows:	Reference remedy and 2 alternates (less aggressive, more aggressive) are presented in the FS.
	1. The reference remedy and alternative remedies **shall** be capable of achieving all of the ROs. The reference remedy **and each** alternative remedy **shall** consist of a remedial strategy under subsection (F) and all remedial measures to be employed. The combination of the remedial strategy and the remedial measures for each alternative remedy **shall** achieve the ROs. […] The reference remedy and other alternative remedies **shall** be developed and described in the FS report in sufficient detail to allow evaluation using the comparison criteria, […].	A reference remedy and 2 alternates (less aggressive, more aggressive) are presented in the FS. The FS describes how the ROs are met, the 3 remedies considered are summarized and evaluated in the comparison to the applicable criteria [A.R.S. § 282.06, and A.A.C. R18-16-407(H)].
	2. The reference remedy **shall** be developed based upon best engineering, geological, or hydrogeological standards of practice, considering the following: a. The information in the remedial investigation; b. The best available scientific information concerning available remedial technologies, and c. Preliminary analysis of the comparison criteria and the ability of the reference remedy to comply with A.R.S. § 49-282.06. […]	The remedies presented are developed based on the RI data and the best professional judgments of the authors (licensed engineers and/or geologists).

Table 3 Technical Evaluation: West Van Buren Working Group (WVBWG)
Proposed Remedy – "Reference Remedy"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
R18-16-407(E)(3)	3. At a minimum, at least 2 alternative remedies **shall** be developed for comparison with the reference remedy. At least one of the alternative remedies must employ a remedial strategy or combination of strategies that is more aggressive than the reference remedy, and at least one of the alternative strategies that is less aggressive than the reference remedy	The remedies presented include a reference remedy and two alternates; one less aggressive, one more aggressive (in comparison to the reference remedy).
R18-16-407(F)(1-6)	The remedial strategies to be developed under subsection (E) are listed below. Source control **shall** be considered as an element of the reference remedy and all alternative remedies, if applicable, except for the monitoring and no action alternatives. […] The remedial strategies are: 1. Plume remediation […] achieve water quality standards for COCs in waters of the state throughout the site. 2. Physical containment […] contain contaminants within definite boundaries. 3. Controlled migration […] control the direction or rate of migration but not necessarily to contain migration of contaminants. 4. Source control […] eliminate or mitigate a continuing source of contamination. 5. Monitoring […] observe and evaluate the contamination at the site through the collection of data. 6. No action […] consists of no action at a site.	The basic remedial strategies are discussed in the FS. Acknowledges that source control by ADEQ is necessary. Physical containment through extraction by RID and monitoring is the current condition; small addition of plume remediation via mass removal/treatment is added. Blending to meet beneficial use by RID is proposed with 1 well replacement (as early as 2019). Future remedial actions are focused on MNA with contingencies to replace/move or otherwise address down-gradient water supply wells, if they become impaired in the future.
R18-16-407(G)	Remedial measures necessary for each alternative remedy developed under subsection (E) to achieve ROs or to satisfy the requirements of A.R.S. § 49-282.06(B)(4)(b) **shall** be identified in consultation with water providers or known well owners whose water supplies are affected by the release or threatened release of a hazardous substance. In identifying the remedial measures, the needs of the well owners and the water providers and their customers, including the quantity and quality of water, water rights and other legal constraints on water supplies, reliability of water supplies and any operational implications **shall** be considered. Such remedial measures may include, but are not limited to: well replacement, well modification, water treatment, provision of replacement water supplies, and engineering controls. Where remedial measures are relied upon to achieve ROs, such remedial measures **shall** remain in effect as long as required to ensure the continued achievement of those objectives.[…]	The FS describes consultation and consideration of RID water supply and use, SRP supply and use, and City of Phoenix (COP) supply and use. RID has noted in their response to comments that they differ with the consultation/consideration presented. Consideration of domestic supply wells (if impaired) in the impacted area is discussed and remedial measures are proposed to connect to the COP supply. This remedial action is planned for any domestic wells in the current plume footprint; the same contingent remedial action is included (as a contingency) for future areas if plume migration into down gradient areas impact any additional domestic supply wells.

Table 3 Technical Evaluation: West Van Buren Working Group (WVBWG) Proposed Remedy – "Reference Remedy"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
R18-16-407(H)(1-3a)	The Department **shall** conduct a comparative evaluation of the reference remedy and the alternative remedies developed under subsection (E). For each alternative, the evaluation **shall** be reported in a FS report and **shall** include:	
	1. A demonstration that the remedial alternative will achieve the ROs.	Demonstration is presented to meet "*protect, restore, replace or otherwise provide a water supply for municipal use by currently and reasonably foreseeable future municipal well owners within the WVB Area".* The focus of the remedial actions are on contingent actions to protect or replace the water supply for reasonably foreseeable future municipal wells.
	2. An evaluation of consistency with the water management plans of affected water providers and the general land use plans of local governments with land use jurisdiction.	FS presents contingency remedial actions to meet RID's future development plans. RID has noted in written comments that they do not support the plan. Plan appears to be supported by other water providers and local governments (COP, SRP).
	3. An evaluation of the comparison criteria, including:	
	a. An evaluation of the practicability of the alternative,	It is practicable however some elements may not be robust: Moving RID-114 to a down gradient position. Projection of plume conditions in 2026 is optimistic based on the estimated rate of attenuation/concentration reductions. Allowing the plume to migrate to COT and/or SRP wells.
	including its feasibility,	Yes, it is feasible.
	short and long-term effectiveness, and reliability,	Contingency remedial actions are implemented when the resource is used for potable water supply and the plume would no longer be contained by irrigation pumping.
	considering site-specific conditions, characteristics of the contamination resulting from the release, performance capabilities of available technologies, and institutional considerations.	Institutional considerations for resolution include water rights, exporting from basin, pumping costs from replacement of wells into the lower aquifer unit, and the water quality and yield of the lower aquifer unit. These are outside of ADEQ's purview. GAC treatment can meet the ROs and project goals however the projection of the effectiveness of monitored natural attenuation (MNA) is optimistic.

Table 3 Technical Evaluation: West Van Buren Working Group (WVBWG) Proposed Remedy – "Reference Remedy"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
R18-16-407(H)(3b-3d)	b. An evaluation of risk, including the overall protectiveness of public health and aquatic and terrestrial biota under reasonably foreseeable use scenarios and end uses of water. This evaluation **shall** address: i. Fate and transport of contaminants and concentrations and toxicity over the life of the remediation; ii. Current and future land and resource use; and iii. Exposure pathways, duration of exposure, and changes in risk over the life of the remediation; iv. Protection of public health and aquatic and terrestrial biota while implementing the remedial action and after the remedial action; and v. Residual risk in the aquifer at the end of remediation.	Remedy is protective under current resource use. Remedy is initially focused on containment (until 2026) then moves to managed migration. Source control remedial actions are to be implemented by ADEQ. The FS presents a risk evaluation including fate and transport, current and future resource use, exposure pathways, duration of exposure, and changes in risk over the life of the remediation, and evaluation of protectiveness of public health. Residual risks will remain in the aquifer.
	c. An evaluation of the cost of the remedial alternative, including the expenses and losses including capital, operating, maintenance, and life cycle costs. Transactional costs necessary to implement the remedial alternative, including the transactional costs of establishing long-term financial mechanisms, such as trust funds, for funding of an alternative remedy, shall be included in the cost estimate.	The FS presents costs for the reference remedy and each alternate. The costs for the proposed remedy (reference remedy) are: $2.6M capital plus $17M operations and maintenance (O&M) for 10 years of treatment and 30 years of monitoring (*includes all contingency remedial actions*). New MWs & sampling (20 yrs sampling) $2.46M Replace 2 SRP wells $5.4M Replace down gradient domestic private wells $0.07M Replace RID 114 (potable use of Salt Canal) $1.23M Continue 18 yrs treatment, 1 well at 500 gpm $18.0M (*Re-inject treated water (18 yrs 500 gpm)* *$5.26M*) 1 new core extraction well at 1,000 gpm (operates for 18 years) $28.1M (*Re-inject treated water (18 yrs 1,000 gpm)* *$8.51M*) **30 years Total $88.6M** The costs presented above represent the sum of costs and are not converted to a net present value basis.
	d. An evaluation of the benefit, or value, of the remediation. This analysis includes factors such as: i. Lowered risk to human and aquatic and terrestrial biota; ii. Reduced concentration and reduced volume of contaminated water; iii. Decreased liability; acceptance by the public; iv. Aesthetics; preservation of existing uses; v. Enhancement of future uses; and vi. Improvements to local economies.	Potable water will be available when required; the remedial action will slowly reduce plume concentration and volume; groundwater resource within current water basin is preserved for future use.

Table 3 Technical Evaluation: West Van Buren Working Group (WVBWG) Proposed Remedy – "Reference Remedy"

FEASIBILITY STUDY STATUTE & RULE APPLICABILITY		TECHNICAL ANALYSIS (see footnotes regarding administrative status for non technical requirements)
R18-16-407(H)(3e)	e. A discussion of the comparison criteria, as evaluated in relation to each other.	Discussion regarding each remedy in relation to each other is present.
R18-16-407(I)	Based upon the evaluation and comparison of the reference remedy and the other alternative remedies developed under subsection (E), a proposed remedy **shall** be developed and described in the FS report. The proposed remedy may be the reference remedy, any of the other alternative remedies evaluated in the FS, or a different combination of remedial strategies and remedial measures that were included in the alternative remedies evaluated in the FS. The FS report **shall** describe the reasons for selection of the proposed remedy, including **all** of the following: 1. How the proposed remedy will achieve the ROs; 2. How the comparison criteria were considered; and 3. How the proposed remedy meets the requirements of A.R.S. § 49-282.06.	The proposed remedy is the Reference Remedy. The FS describes how the ROs are met. The FS describes the consideration of comparison criteria. The FS describes how the recommended remedy meets the A.R.S. requirements.
R18-16-407(J)	Any person, other than a person proposing to perform work under an agreement under A.R.S. § 49-287.03(C), may submit a request in compliance with R18-16-413 for the Department to approve a work plan or a report for all or any portion of a feasibility study. The Department **shall** approve a feasibility study report if the feasibility study complies with this Section and community involvement activities have been conducted under this Article.	Administratively complete for work plan requirement (3). Technical evaluation/analysis presented in the FS and the community involvement activities that have been completed comply with the referenced section and article.

(1) Administrative requirement; the FS submitted (and this specific remedial alternative) meets this threshold

(2) Not applicable to site status, WQARF process and ADEQ remedy selection.

(3) Process step that is applicable under WQARF and it has been completed (or in process of completion)

References:

ADHS, 2015. Health Consultation: Evaluation of Water Sampling Results in the Roosevelt Irrigation District (RID) Phoenix, Maricopa County, Arizona. Arizona Department of Health Services. January 8, 2015.

JULIE CARVER, PE
PROGRAM MANAGER

AREAS OF EXPERTISE

Project and Program Management

Redevelopent of Contaminated Property

Environmental Investigation

Environmental Remediation

Regulatory Agency Negotiations

Stakeholder Consensus Building

EDUCATION

Master of Science in Environmental Science and Engineering, Colorado School of Mines, 1996

Bachelor of Science in Geological Engineering, South Dakota School of Mines & Technology, 1986

PROFESSIONAL REGISTRATIONS

Registered Professional Engineer, Arizona (#58115): 2014 to Present

Registered Professional Engineer, Alabama (# 27191): 2005 to Present

Registered Professional Engineer, Colorado(#33746): 1993 to Present

Registered Professional Engineer, Georgia (#34270): 2009 to Present

Registered Professional Engineer, Kansas (#20804): 2009 to Present

Registered Professional Engineer, New Jersey (#24GE05063100): 2013 to Present

Registered Professional Engineer, Virginia (#042950): 2006 to Present

NCEES Record #27168

CONTINUING EDUCATION/TRAINING

OSHA (29 CFR 1910.120) 40-Hour HAZWOPER and 8-Hour Supervisor

AHERA (40 CFR 763.206) Asbestos Building Inspector & Management Planner

NPDES (40 CFR 122) Stormwater Management & Erosion Control "Qualified Person"

PROFESSIONAL SUMMARY

Ms. Carver is a registered professional engineer with over 27 years of public and private-sector experience in the assessment and remediation of sites burdened with environmental contamination. Julie offers a broad range of experience managing multi-disciplinary, cross-functional teams whose purpose is to solve logistically complex, diverse contaminated property issues on programs and projects for both public and private-sector clients. She provides expertise in the assessment and remediation of hazardous substances and wastes, special wastes, and munitions and explosives of concern (MEC), stakeholder consensus building, and regulatory agency compliance and negotiations. Ms. Carver has worked on sites across the United States and the Asia Pacific, including brownfield, municipal, quasi-governmental and private-sector redevelopment sites, active military installations, Base Realignment and Closure (BRAC) Sites, and Formerly Used Defense Sites (FUDS). She is a nationally-recognized speaker on accelerated environmental closure of contaminated properties in conjunction with redevelopment and beneficial use. As a Vice President with Matrix, she has access to all professional resources within the company and authority to assign work for completion.

RELEVANT EXPERIENCE

McClellan Development Site, Anniston, Alabama - Project Manager to the McClellan Development Authority's Program Management Team responsible for developing remedial designs and providing remediation oversight for the closure and long-term monitoring of seven historical legacy landfills contaminated primarily with CERCLA hazardous substances and limited MEC. Also responsible for developing an active operations plan and updated closure plan for a RCRA -permitted landfill, the remediation of multiple sites with solvent contaminated soil and groundwater and technical peer-review of remedial designs for the cleanup of soil contaminated with metals and munitions constituents at this mixed-use redevelopment/BRAC property.

Fort Monroe Redevelopment, Hampton Roads, Virginia - Program Manager responsible for providing technical oversight services to the quasi-governmental redevelopemnt authority for the investigation of CERCLA hazardous substances and MEC at this 2005 BRAC site, which is a National Historic Landmark. On behalf of our client and the Commonwealth of Virginia Attorney General's Office, provided technical expertise for the development and implementation of remedial investigations, feasibility studies and records of decision/remedial action plans for firing ranges, groundwater contaminated with solvents in a marina, a historical legacy landfill, underground storage tanks, and contaminated sediment in a moat

Fitzsimons Life Sciences District, Denver, CO - Technical Program Manager to the City of Aurora and Fitzsimons Redevelopment Authority responsible for the $14.5M investigation and cleanup of 3 historical landfills under a RCRA Consent Agreement integrated with the $8.5M design and construction of a 2-mile long, 4-lane bypass and a utility upgrade necessary to accommodate significant redevelopment on this 500-acre bioscience and medical facilities redevelopment.

McPherson Redevelopment, Atlanta, GA - Program Manager to the McPherson Implementation Local Redevelopment Agency responsible for the due diligence assessment of environmental contamination at this ~500 acre former military installation. This site is located in the immediate vicinity of downtown Atlanta and the Atlanta International Airport and will be redeveloped as a bioscience park and mixed use transit oriented development.

Matrix ENVIRONMENTAL

JULIE CARVER, PE
PROGRAM MANAGER

Hamilton Field, Novato, CA - Deputy Project Manager for the accelerated assessment and cleanup of soil contaminated with metals, fuel and polyaromatic hydrocarbons from former aircraft maintenance facilities and fuel storage at this BRAC property located north of San Francisco. Implemented Early Response Actions using bioremediation and low-temperature thermal desorption so that redevelopment at this former industrial/military property allowing residential redevelopment to proceed.

Liberty Station, San Diego, CA - Project Manager to the San Diego Redevelopment Authority responsible for the development of a detailed human health and ecological risk assessment based on historical investigation work performed by others, and the development of a financial cost model for a potentially-responsible party cost allocation analysis related to the environmental cleanup of contaminated sediments in San Diego Bay.

Uptown Oakland Redevelopment, CA - Environmental Program Manager to Forest City in partnership with the City of Oakland responsible for the initial environmental assessment and characterization of an underutilized, four city-block Brownfield site which was subsequently redeveloped into apartment homes, neighborhood retail and a public park.

Hunter's Point, San Francisco, CA - Program Manager responsible for the implementation of a $14 M RI/FS for a landfill located on San Francisco Bay, the $5.0M assessment and cleanup of a tank farm with a network of over 50 USTs and ancillary pipelines, and the completion of three time critical removal actions involving cleanup of soil and groundwater contaminated with heavy metals, solvents, pesticides and/or PCBs.

Underground Storage Tank/Aboveground Storage Tank (UST/AST) Closures, Western United States and the Asia Pacific - Regional Program Manager to the Federal Emergency Management Agency responsible for the investigation/characterization of fuel releases from storage tanks at Emergency Broadcast Stations, and the subsequent preparation of detailed plans, specifications and cost estimates and construction oversight for the removal and/or closure in place of over 100 USTs and ASTs.

RCRA Subtitle C and D Landfill Closure Systems, United States and Asia Pacific - Project Manager under a contract with the U.S. Air Force responsible for completing landfill characterization work, landfill closure designs and third-party construction management for RCRA Subtitle C and D landfills in Alabama, Arkansas, Colorado, Guam, Louisiana, Maine and Washington.

Aboveground and Underground Mine Closures, CO, NM, AZ, WA - Project Manager for private-sector mining clients responsible for providing regulatory analysis/compliance services, the implementation of environmental investigations and regulatory agency negotiation assistance related to the development of closure plans.

Aliamanu Remedial Investigation, HI - Project Manager responsible for completion of a multi-million dollar remedial investigation, including a CERCLA human health and ecological risk assessment in a military housing area on property that was formerly used as a pineapple plantation..

Matrix ENVIRONMENTAL

Tom McKeon, P.E.
Senior Project Manager (CALIBRE Systems)

EDUCATION
M.S., Civil Engineering, University of Washington
B.S., Environmental Engineering, Humboldt State University

EXPERIENCE
Mr. McKeon is a Principal Environmental Engineer with CALIBRE who has specialized in the investigation/analysis of environmental problems and design of remediation systems. He has over 30 years professional experience with a primary focus on sites with soil and groundwater contamination. He has completed numerous site characterization studies, development of hydrogeologic site models, and designed/installed/optimized soil and groundwater treatment systems. Mr. McKeon is a Professional Engineer (P.E.) with experience addressing environmental and regulatory issues at disposal sites, industrial facilities, and landfills throughout the United States and internationally. He has developed expertise in a wide range of compliance issues including regulations under RCRA, CERCLA and the Clean Water Act. Project experience has included technical and regulatory compliance work for the Nuclear Regulatory Commission, Department of Energy, Department of Defense, Environmental Protection Agency, and private industries.

SOIL AND GROUNDWATER REMEDIATION EXPERIENCE
Remedial Action using Soil Vapor Extraction (SVE), Air Sparging and In-well Stripping. Mr. McKeon has been the lead engineer for dozens of in-situ remediation projects using SVE, air sparging and in-well stripping. Projects have included multiple sites in California, Nevada, Arizona, Washington and international projects in France, Denmark and Taiwan. Responsibilities in these projects have included design, construction oversight, startup, and optimization. He has written remediation design guidance published by the American Soceity of Civil Engineers (ASCE) and taught courses on remedial systems design/optimization for the National Ground Water Association (NGWA) and US consulting companies.

Remedial Actions using In-situ Groundwater Treatment at Dry Cleaning Sites. Mr. McKeon has been the lead engineer for remedial actions at multiple sites with perchloroethene (PCE) contamination. Project responsibilities have included system design, construction oversight, startup/optimization and operation/maintenance. Projects have included multiple sites in California, Nevada, Washington, and Oregon. Most recent projects (in the last 10 years) have focused on SVE with biological treatment (enhanced reductive dechlorination) for groundwater. The projects have demonstrated excellent performance with PCE concentration reductions of 99.99+% achieved (meeting water quality criteria).

Completing Remedial Investigation/Feasibility Studies (RI/FS) for Protection of City Water Supplies. Mr. McKeon has been the project manager of several RI/FS projects to address solvent impacts to City water supply wells (Santa Barbara and Modesto, California, and Vancouver Washington). Customers have included US EPA and local industries. Remedial actions implemented include well-head treatment (at supply wells) and source-area/plume wide treatment.

Performance-Based Contracting. Mr. McKeon provides consulting support for federal agency procurement of environmental restoration services. Recent projects for the DOD include work for the Army, Air Force, and Navy related to project scoping, planning, and performance-based contracting.

Licensed Civil Engineer, current in Washington and Arizona. Registered with National Council of Examiners for Engineering and Surveying (NCEES, Record # 16876).

Preferred Remedy Cost Summary
West Van Buren Area WQARF Site
Phoenix, Arizona

	Year (Period)	Non Disc., with 3% Inflation			NPV @ 6% Disc. Rate		
		Capital	Total O&M	Total	Capital	Total O&M	Total
Base							
Groundwater monitoring program	2016-2044		$10.11	$10.11		$3.04	$3.04
Connect five impaired private wells within the WVBA to the COP municipal system	2016	$0.05		$0.05	$0.05		$0.05
Trust Creation Expense	2016	$0.10		$0.10	$0.10		$0.10
Conduct a hydrogeological evaluation beginning in 2019, and every 3 years thereafter through 2025 (3 total at $30K each)	2019-2025	$0.09		$0.09	$0.09		$0.09
Base Total		**$0.24**	**$10.11**	**$10.35**	**$0.24**	**$3.04**	**$3.28**
Contingencies							
Install one (1) plume core extraction well at 500 gpm and operate well through 2044	2026-2044	$3.50	$18.03	$21.53	$1.37	$2.82	$4.19
Re-inject 500 gpm treated water	2026-2044	$3.76	$1.50	$5.26	$1.31	$0.24	$1.55
Drill and construct nine (9) new sentinel monitoring wells	2026	$0.65		$0.65	$0.23		$0.23
Quarterly monitoring of sixteen (16) sentinel wells and eleven (11) SRP wells	2026-2044		$1.81	$1.81		$0.28	$0.28
Replace two (2) SRP wells with new, collocated LAU wells	2030	$5.37		$5.37	$1.32		$1.32
Connect five (5) private wells outside the WVBA to the COP municipal system	2026	$0.07		$0.07	$0.02		$0.02
Replace RID-114 with a new UAU production well at a different location	2019	$1.23		$1.23	$0.79		$0.79
Add one (1) plume core extraction well at 1,000 gpm and operate well through 2044	2026-2044	$3.67	$24.43	$28.10	$1.28	$3.82	$5.10
Re-inject 1,000 gpm treated water	2026-2044	$5.98	$2.53	$8.51	$2.08	$0.40	$2.48
Contingency Total		**$24.23**	**$48.30**	**$72.53**	**$8.40**	**$7.56**	**$15.96**

Total Cost		Non Disc., with 3% Inflation	NPV @ 6% Disc. Rate
Base		$10.35	$3.28
All Contingencies		$72.53	$15.96
Total		$82.88	$19.24

Notes
Costs in Millions

WVBA = West Van Buren Area
WQARF = Water Quality Assurance Revolving Fund
Disc. = Discounted
O&M = Operations and Maintenance
COP = City of Phoenix
gpm = gallons per minute
SRP = Salt River Project
LAU = Lower Alluvial Unit
UAU = Upper Alluvial Unit